

SN-031-0419



Ballantine



Ballantine



1010A

DUAL TRACE OSCILLOSCOPE

BALLANTINE LABORATORIES, INC.

P.O. BOX 97

BOONTON, NEW JERSEY 07005 USA

201-335-0900/TWX: 710-987-8380

90100271A

JUNE 1973

Warranty

All Ballantine Laboratories, Inc. products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, except for vacuum tubes and batteries, or, in the case of certain major components listed in the instruction manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned prepaid to Ballantine. No other warranty is expressed or implied. We are not liable for consequential damages.

CERTIFICATION

The equipment supplied on your order meets all applicable published Ballantine specifications as determined by thorough testing and inspection. Ballantine's calibration measurements are traceable to the National Bureau of Standards. All instruments used in calibrating Ballantine products are standardized by systematic reference to NBS-traceable standards as described in the validation procedures shown below.

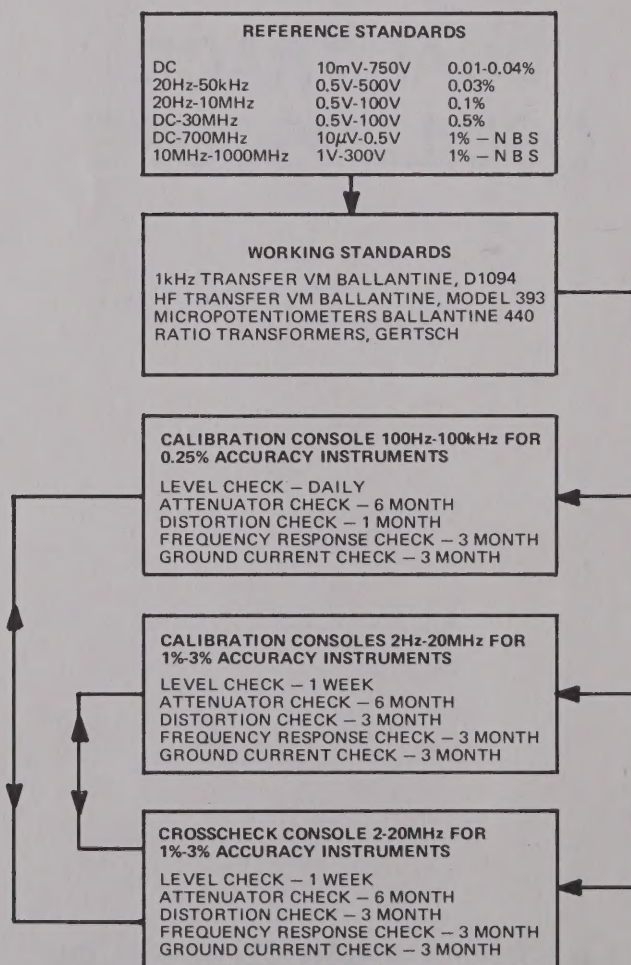
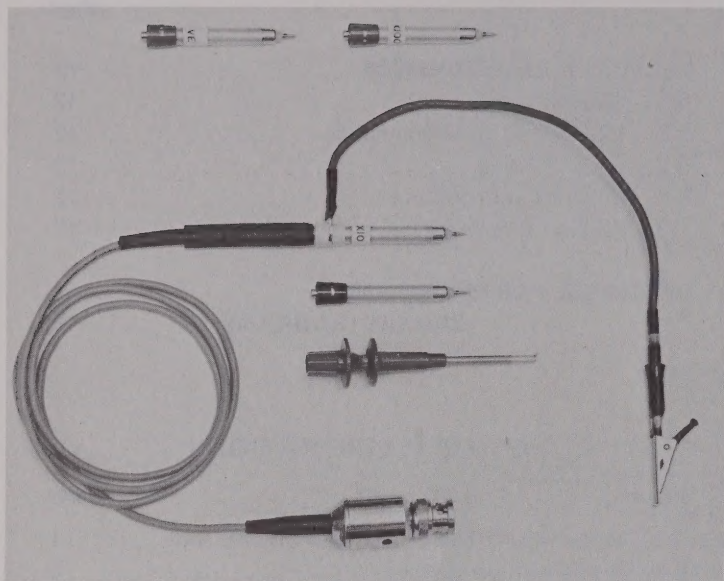


TABLE OF CONTENTS

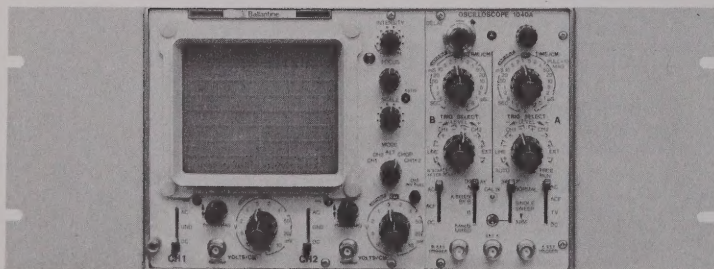
	<i>Page</i>		<i>Page</i>
SECTION 1. GENERAL INFORMATION	1	SECTION 5. MAINTENANCE	12
SECTION 2. SPECIFICATIONS	2	5-1. General	12
SECTION 3. OPERATION	3	5-2. Removal of Sub-Assemblies	12
3-1. Switching On	3	5-3. Fault Finding	13
3-2. Obtaining a Trace	3	5-4. Calibration Procedure	13
3-3. Setting up Y Channels	3	5-5. Packing Information	17
3-4. Single Trace	3	SECTION 6. PARTS LIST AND	
3-5. Dual Trace Operation	3	CIRCUIT DIAGRAMS	18
3-6. Timebase and X Expansion	4		
3-7. X-Y Mode	4		
3-8. Trigger	4		
3-9. Additional Facilities	4		
3-10. Electronic Signal & Transient Storage	6		
3-11. Camera	6		
3-12. Phase Shift Measurements	6		
SECTION 4. PRINCIPLES OF OPERATION	7		
4-1. General	7		
4-2. The Y Amplifiers	8		
4-3. The Beam Switch	9		
4-4. The Trigger Circuits	9		
4-5. The Timebase Bistable Multi and Ramp Generator	9		
4-6. Bright Line Auto Circuit	9		
4-7. The X Output Amplifier	10		
4-8. X-Y Mode	10		
4-9. Power Supplies	10		
4-10. Calibrator	11		
4-11. Blanking	11		
4-12. CRT Network	11		
		LIST OF ILLUSTRATIONS	
		<i>Figure</i>	<i>Page</i>
		1-1. Ballantine 1010A Dual Trace Oscilloscope	1
		3-1. Probe Compensation	5
		3-2. Amplitude/Sensitivity Calibration	5
		3-3. Phase Shift Measurements	6
		3-4. Typical Setup Using 7050A Electronic Signal Recorder	6
		4-1. Block Diagram	7
		4-2. Scope Adjustment Using 6125A Oscilloscope Calibrator	11
		5-1. Horizontal Time Calibration	16
		5-2. Ballantine 6125A Calibrator Waveforms	16
		6-1. Interconnection Diagram	19
		6-2. 'Y' Amplifier	21
		6-3. Timebase & 'X' Amplifier	23
		6-4. Power Supply	25
		6-5. 1010A Top View	27
		6-6. 1010A Bottom View	28



10600B PROBE & ACCESSORIES

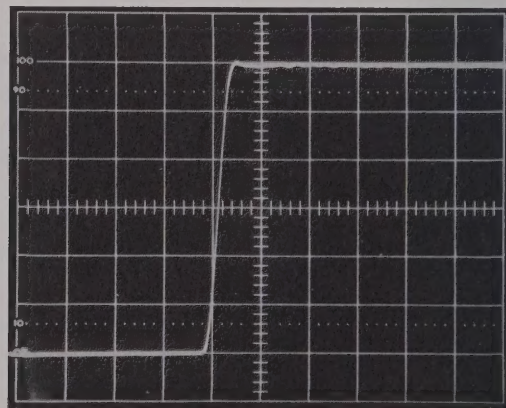


RACK MOUNT ASSEMBLY



(Above rack mount shows 1040A Oscilloscope)

Refer to page 2 for a listing of the optional accessories available for use with the 1010A Oscilloscope.



PULSE RESPONSE

Input $T_R \approx 750 \text{ ps}/50 \Omega$
Scope Rise Time $\approx 35 \text{ ns}$

General Information

The 1010A general purpose oscilloscope is a solid state, portable, dual trace oscilloscope suitable for a diverse number of laboratory and field maintenance applications. Bandwidth at the -3 dB points is DC to 10 MHz, and AC mode bandwidth is 2 Hz to 20 MHz. Rise time is 35 nsec.

Sensitivity from 5 mV/cm to 20 V/cm is covered in 12 switched ranges. Several display modes are incorporated: CH1 or CH2 single trace; CH1 and CH2 dual trace with alternate sweep or 250 kHz chopped and automatically selected by the setting of the timebase switch; X-Y in which the precision attenuators in one Y channel are utilized to control the amplitude of the X signal.

Sweep speeds from 0.5 S/cm to 1 $\mu\text{s}/\text{cm}$ are covered in 8 switched ranges with a common variable overlap control effective on all ranges. A X 10 magnifier is incorporated so that the sweep speed can be increased to 100 ns/cm.

Switch selected trigger sources are, internal from either one of the two Y channels, and external via a front-panel BNC connector. A facility for triggering from television signals is also incorporated.

Level control may be effected manually or automatically. In the absence of trigger signals in the 'Auto' mode, the timebase switches to an automatic free run condition and produces a bright line trace. A special feature of the 1010A scope is trigger level control in the 'Auto' mode.

The cathode ray tube provides a full 8 X 10 cm display. The CRT operates at a full 3600 volts of accelerating potential to provide an exceptionally bright display for this class of scope. The display is easily viewed in well illuminated work areas.

The 1010A is a rugged, easy to maintain, and its 7 kg (15 lbs.) weight makes it the lightest portable dual trace scope with a full size CRT.

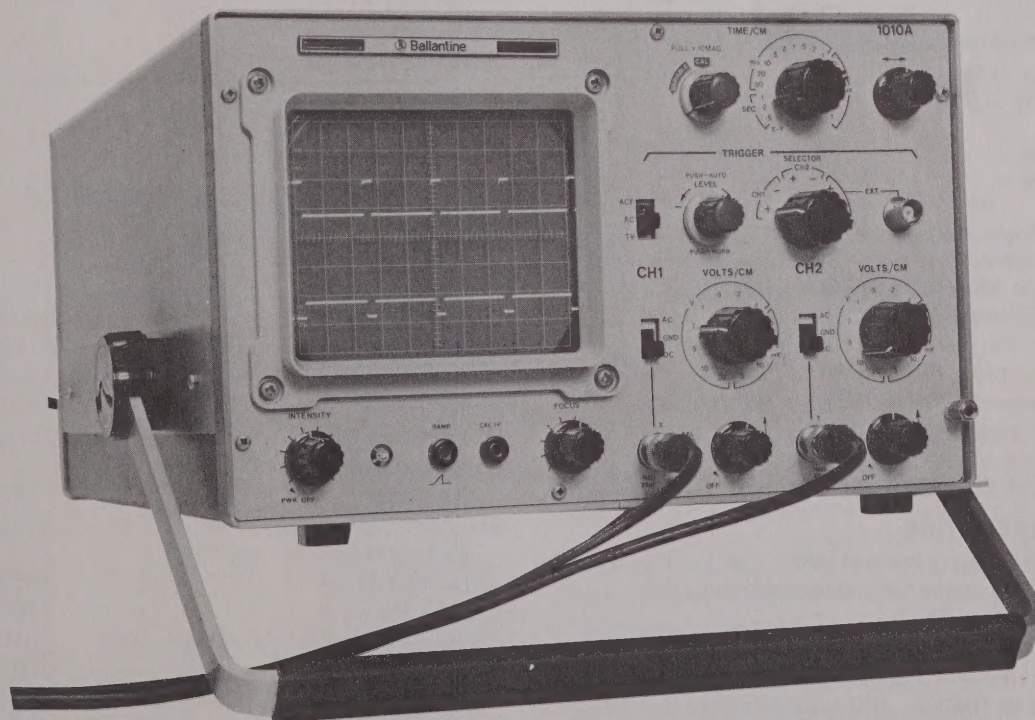


Figure 1-1. Ballantine 1010A Dual Trace Oscilloscope

Section 2

Specifications

DISPLAY

5 in flat faced CRT giving 8 cm X 10 cm display
3.6 kV overall accelerating voltage.

Phosphor—P31. Long persistence (P7) available as an option.

VERTICAL DEFLECTION

Two identical input channels. CH1 and CH2
Bandwidth DC—10MHz. (2 Hz—10MHz on AC) at -3dB
Sensitivity 5 mV/Cm to 20V/cm in 1-2-5 sequence.
12 positions with 1-2-5 sequence.
Accuracy $\pm 5\%$
Input Impedance $1M\Omega$ /approx. 28 pF.
Input coupling DC—GND—AC.
Protection 400V DC or pk AC to 1KHz. Derated linearly to 10 volts at 10MHz.

DISPLAY MODES

Single Trace CH1 or CH2.
Dual Trace chopped or alternate modes, automatically selected on timebase switch. Chop rate approx. 250kHz.
X-Y mode with CH1 input giving X deflection and CH2 input giving Y deflection.
Bandwidth DC to 500kHz. $<3^\circ$ phase shift at 20kHz.

HORIZONTAL DEFLECTION

Timebase— $1\mu s/cm$ to 0.5s/cm in 18 ranges (1-2-5) sequences.
Accuracy $\pm 5\%$
X Expansion—X10 pull switch gives fastest speed of 100 ns/cm. Accuracy $\pm 5\%$.
Variable control gives $>2.5:1$ reduction in sweep speed to 1.25 sec/cm and 12.5 sec full screen

TRIGGER

Variable level control with option of bright line AUTO sync in absence of signal. Sweep free-runs in absence of signal in AUTO mode.

Trigger level control range (Normal and Auto mode)

INTERNAL $> 8cm$
EXTERNAL $> 20V$

Source:

Internal CH1 + or -
CH2 + or -

External + or -

External trigger input impedance, approx $100k\Omega/10pF$.
BNC connector

Protected to 100V DC and 100V pk AC

Coupling AC, AC fast, TV Frame.

Sensitivity:

Internal	2mm approx. 40Hz—2MHz.	AUTO triggering
External	1V approx. 40Hz—2MHz.	with level
Internal	1cm approx. 8Hz—10MHz.	Manual Level
External	5V approx. 8Hz—10MHz.	

Internal 2cm pk/pk video on TVF

ADDITIONAL FACILITIES

Calibrator: 1V $\pm 2\%$ square wave at power line frequency.

Risetime $\approx 20\mu s$ (usable for probe compensation)

Source Impedance $\approx 1K\Omega$

Ramp output: 0 to 10 volts. Source Impedance $18K\Omega$

Axis Modulation Input: AC coupled. 10V gives visible modulation (2Hz to 10MHz). 70V gives full blanking.

SUPPLY

95-111V; 103-121V; 111-130V; 48 to 440 Hz

190-222V; 206-242V; 222-260V;

Approx. 20 watts

TEMPERATURE RANGE

Operating: 0 to $50^\circ C$

Full Accuracy $15^\circ C$ to $35^\circ C$

Nominally 2% additional tolerances from $0^\circ C$ to $15^\circ C$
and $35^\circ C$ to $50^\circ C$

Storage: $-40^\circ C$ to $+75^\circ C$

ALTITUDE

Operating 3Km (10Kft)

Storage 15Km (50Kft)

HUMIDITY

Constant operation at $40^\circ C$ and 90% relative humidity.

Intermittent operation within the specified temperature range and all humidity conditions which prevent condensation.

TRANSIT

Unit will meet National Safe Transit test when factory packaged. Vibration for one hour at 1.2G and 76 cm (30 inch) drops on corners, edges and flat surfaces.

DIMENSIONS

18cm (7") X 29cm (11 3/8") X 42cm (16 1/2")

Approx. 7 kg (15 lbs.).

Rack mount option (800-0 Kit)

Width — 483mm (19 in.)

Depth behind panel — 395mm (15 1/2 in.)

Height — 180mm (7 in.)

SUPPLIED ACCESSORIES

1 each Instruction manual

1 each Power cord (31100000A)

1 each CRT filter blue

AVAILABLE ACCESSORIES

Probe Kit, Attenuator 10:1; $10M\Omega$, 11 pF;

110 mm (3 1/2 ft.) 10600A/B

150 mm (5 ft.) 10601 A/B

RF Detector head for probe (200MHz) 85100120A

Viewing Hood 8 x 10 cm 10702A

Protective Soft Luggage Style Cover 10725A

Cover, Front Panel 10750A

Calibrator; Amplitude, Time and
Rise time 6125A

Electronic Storage Recorder
Endless Magnetic Tape loop
DC to 100 kHz 7050A/B

Camera, Polaroid 7000A

Camera, Polaroid 8 x 10 Adapter Bezel 36100060A

Rack mount assembly 800-03

with BNC Feedthru connectors 800-02

Cable, BNC to BNC 120 mm (48 in.) 12249D

Cable, BNC to BNC 22 mm (8 in.) 12249A

Cable, BNC to Alligator Clips
120 mm (48 in.) 12250A

Termination, 50Ω , BNC Feedthru 12630A

Operation

3-1. SWITCHING ON

CAUTION

The 1010A relies on convection cooling and must always be operated in a position such that external air circulation is not restricted.

1. Set the support/carrying handle to the required operating position. The handle is released by pulling both detent bushings outward, and it may then be turned to lock in any one of 5 positions.

CAUTION

Connection of the 1010A to 220 volt power while wired for 115 volt power may cause serious damage and will void the warranty.

2. Check that the supply transformer taps are wired for the correct power supply voltage. (see section 5).
3. Turn the INTENSITY control clockwise beyond the OFF setting and check that the indicator lamp lights.

3-2. OBTAINING A TRACE

1. To obtain a trace
 - (a) Set the CH1 position control to approximately mid setting
 - (b) Set the CH2 position control to OFF.
 - (c) Set the X position control to approximately mid setting.
 - (d) Set the TRIG level Control to normal (auto) position and mid range i.e. not pulled out for BRIGHT LINE OFF.
 - (e) Set the TIME/CM switch to $5\mu\text{s}$
 - (f) Adjust the INTENSITY control to obtain a display of the required brightness.
 - (g) Center the display by adjusting the CH1 and X position controls.
 - (h) Adjust the FOCUS control to obtain a sharply defined trace.

3-3. SETTING UP THE Y CHANNELS

1. Using a coaxial input signal cable, connect a signal to the CH1 or CH2 input BNC connectors.
2. For
 - (a) Direct connection of the input signal, set the associated AC-GND-DC input slide switch to DC.
 - (b) Capacitive coupling of the input signal through an internal $0.1\mu\text{F}$ 400V capacitor, set the slide switch to AC.

NOTE

When examining low amplitude a.c. signals superimposed on a high d.c. level, the slide switch should be set to AC and the sensitivity of the Y amplifier increased as in (4).

3. To locate the baseline, set the slide switch to the 'ground' setting. At this setting, the input signal is open circuit and the input of the amplifier is switched to ground.
4. To select the sensitivity, set the VOLTS/CM switch to the required range. To minimize pick up at sensitive settings, it is essential that the ground lead connection is near to the signal point.
5. For vertical shift of the trace, adjust the Y position controls (identified with vertical arrows).
6. Any trace movement under no signal conditions, when the setting of the VOLTS/CM switch is altered, can be minimized by adjustment of the BAL screw driver adjustments.

NOTE

This control will only need adjustment at infrequent intervals. Before adjusting the BAL preset control ensure that the input slide switch is set to the 'ground' setting.

3-4. SINGLE TRACE

1. For single trace operation on CH1 set
 - (a) The CH1 position control beyond the OFF setting.
 - (b) The CH2 position control to OFF.
2. For single trace operation on CH2, set
 - (a) The CH2 position control beyond the OFF setting.
 - (b) The CH1 position control to OFF.

3-5. DUAL TRACE OPERATION

In the dual trace mode, the Y channel switching function is in operation and results in independent display of two input signals. Two modes of beam switching — chopped and alternate — are used. They are automatically selected by the setting of the TIME/CM switch. At any fast setting from $1\mu\text{s}$ to 0.5ms, inclusive, the alternate switching mode is in operation. At slow settings from 1 ms to 0.5s inclusive, the chopped switching mode is in operation.

For dual trace operation, rotate both:

- (a) The CH1 position control to its operating range
- (b) The CH2 position into its operating range

3-6. TIMEBASE AND X EXPANSION

The sweep speed of the internal timebase (i.e. the time scale of the horizontal axis) is determined by the setting of the TIME/CM switch. (The setting of the switch automatically determines which mode of beam switching is used during dual trace operation.) In addition to selection of the speed of the internal timebase, the switch has one further position, X-Y, which makes the internal timebase inoperative.

1. To adjust the time scale of the horizontal axis:
 - (a) Set the TIME/CM switch to a suitable setting.
 - (b) If necessary rotate the uncalibrated VARIABLE control. It is normally placed in the clockwise "calibrated" position.

NOTE

The range of the VARIABLE control is approximately 3:1. Except at the CAL (cw) setting, the VARIABLE control is uncalibrated. At the CAL setting, the calibration corresponds to the setting of the TIME/CM switch.

2. For horizontal position of the trace, adjust the X position control (identified by horizontal arrow).
3. If close examination of any portion of the trace is required, operate the PULL X10 control. This facility is available at all settings except X-Y of the TIME/CM switch, and effectively increases the sweep length from 10cm to 100cm. Any portion of the increased sweep length may be selected for viewing on the display by use of the X position control.

3-7. X - Y MODE

When the TIME/CM switch is set to X-Y, the CH1 input is switched to the X amplifier. Under this condition, an external signal applied to the X (CH1) BNC is routed through the input attenuators in CH1, and the full range of the sensitivity may be utilized to obtain a calibrated horizontal deflection. Only single trace operation (CH2 Y input) is possible. In this mode, the CH1 position control is inoperative and the X position control moves the trace horizontally. The X bandwidth is limited to 500KHz and thus the relative phase shift between X and Y is significant only above 20 KHz. It is less than 3° to 20 KHz and typically < 8° to 100 KHz.

3-8. TRIGGER

The timebase may be triggered from the positive or negative slope of the signal selected by the TRIG SELECT switch as follows:

- (a) CH1 or CH2 signal (irrespective of which beam is displayed).
- (b) An external triggering source connected to the EXT TRIG BNC connector.

When the LEVEL control is pulled out to select normal manual Trigger Leveling, the timebase will only trigger when the trigger signal reaches the selected level. When the LEVEL control is set outside the range of signal or when there is insufficient signal amplitude the timebase will not run and the screen will remain blank.

The Auto mode of operation is with the LEVEL control pushed in, when the timebase will free run in the absence of the correct trigger to display a bright line or unsynchronised display until the level control is adjusted and/or the amplitude of the trigger signal is increased. This free run action in the absence of correct trigger helps in finding the trace and leads to ease of operation. If the timebase is required to free run continuously, the LEVEL control should be set to either end of its rotation.

The ability to level select in Auto mode is a feature of this oscilloscope.

It is expected that the Manual Level (Pull) mode will be selected only when the instrument is to be used to display signals at low or high repetition rates.

The TRIG SELECT switch is used in conjunction with the ACF-AC-TVF slide switch. This switch connects different networks into the trigger amplifier circuit and is effective at all settings of the TRIG SELECT switch. The operating facilities available at the three settings of the slide switch are as follows:

- AC Wideband trigger mode used for most signals.
- ACF A filter is switched into circuit to reject low frequencies. High frequency triggering may be effected from complex waveforms such as those with high ripple content or line triggering from a television video signal waveform.
- TVF A filter is switched into circuit to reject high frequencies. Its cut off is chosen to accept the frame sync of a TV video waveform and reject the TV line frequency component.

Triggering control is accomplished as follows:

1. Set the TRIG SELECT switch to select the required trigger signal and slope.
2. Set the ACF-AC-TVF switch to the required setting.
3. Adjust the LEVEL control so that the trace starts at the required point on the waveform.

3-9. ADDITIONAL FACILITIES

(a) Cal

This connector provides a DC coupled positive-going square wave of $1V \pm 2\%$ amplitude at line frequency for calibration checks. The square wave has a source impedance of $1k\Omega$ and a rise time of approximately $20\mu S$. Time base may be checked for calibration by observing 3 cycles at 60Hz power line and 2 1/2 cycles at 50Hz power line when the TIME/CM switch is set to 5 mS/cm. (See Fig. 3-2)

(b) Ramp

This jack on the front panel provides a d.c. coupled positive-going timing ramp of approximately 10V amplitude generated by the timebase. Source impedance is $18k\Omega$.

(c) Z Mod

The jack on the rear panel allows an a.c. coupled signal to modulate the brightness. Coupling is by an internal $0.02\mu F$ capacitor into $4.7M\Omega$. The input resistance at this jack is $100k\Omega$. (2Hz - 10MHz)

1. Sensitivity is approximately 10V pk-pk for visible modulation at normal brightness.
2. Full blanking requires a 70V negative-going pulse.

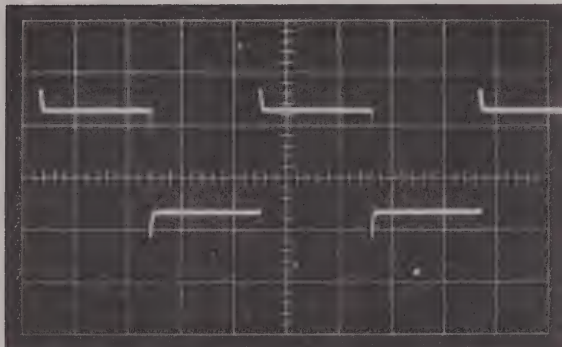
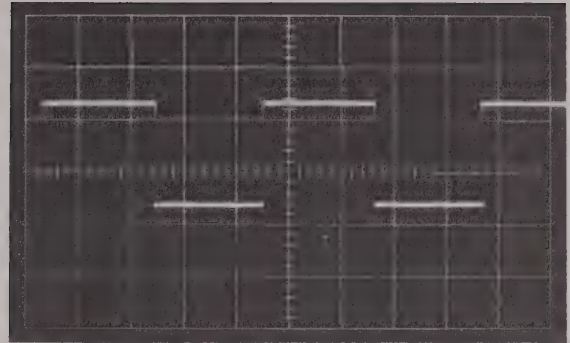
PROBE COMPENSATION

Using CAL 1 V jack on panel

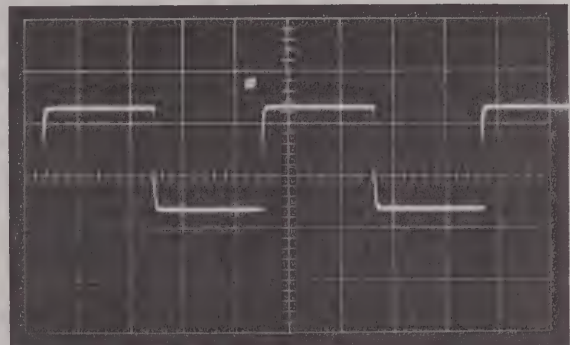
0.5 V/cm Y

5 ms/cm X

Proper Adjustment of Probe
Compensating Capacitor

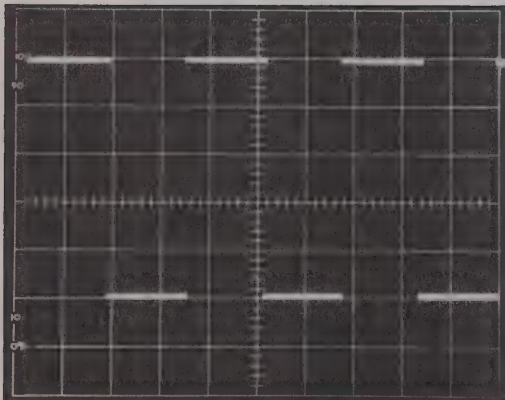


Over Compensated



Under Compensated

Figure 3-1. Probe Compensation



Amplitude/Sensitivity Calibration

Direct input to dc coupled input of
amplifiers

Attenuators set at 200 mV/cm

Line Frequency Square Wave from
Cal 1 V jack on panel

200 mV/cm Y

5 ms/cm X

Figure 3-2. Amplitude/Sensitivity Calibration

(d) Use of Optional Attenuator

A X10 passive probe may be used to extend the voltage range and increase the input impedance of the Y amplifiers. The input resistance of a Y channel is $1\text{M}\Omega$, shunted by approximately 28 pF. The effective capacity of the input lead must be added to this and the resultant impedance can often load the signal source. Therefore it is advisable to use the $10\text{M}\Omega$ X10 probe, 10601A. This reduces the input capacity and increases the input resistance, at the expense of the sensitivity. The probe contains a shunt RC network in series with the input and forms an attenuator with the input RC of the Y channel. To obtain a flat frequency response it is necessary to adjust the capacitance of the probe to match the input capacity of the Y channel as follows:

1. Set the Y channel VOLTS/CM switch to 0.02V, and the TIME/CM switch to 5 ms.
2. Connect the probe to the CAL 1V. Adjust the probe compensating capacitor for level response with no overshoot or undershoot visible in the display. (See Fig. 3-1)

3-10. ELECTRONIC SIGNAL & TRANSIENT STORAGE

To obtain "storage" display operation Ballantine provides the 7050A endless magnetic loop tape recorder. Transients are readily recorded and displayed electrical recall and delayed sweep expansion is possible for window of 20 ms and risetime of $3.5\text{ }\mu\text{sec}$.

3-11. CAMERA

A camera may be attached to the oscilloscope to record waveforms. This facility is particularly useful for the slow speed timebase settings. The Ballantine 7000A polaroid camera is recommended with 8 X 10 cm Bezel, Ballantine 36100060A.

3-12. PHASE SHIFT MEASUREMENTS

Phase shift measurements are usually made when the frequencies of the two input ac signals are equal. Hence, Lissajous figures that result from a phase difference between

two input signals of the same frequency are often referred to as phase difference patterns. When using very low frequency sine waves, dc coupling should be used to eliminate phase shifts due to the coupling circuits.

To check the relative phase shift, proceed as follows:

1. Apply one sine wave signal to X INPUT and the second signal to Y INPUT.
2. Center the trace horizontally and adjust the Y controls for 8 centimeters of vertical deflection. The pattern obtained should be similar to Figure 3-3.
3. The angle between the two signals is that angle whose sine is the ratio A/B.

NOTE

To obtain full scale vertical deflection of 8 centimeters, it may be necessary to temporarily reduce the horizontal amplitude of the display. To accomplish this, set the X VOLTS/CM switch one step counterclockwise from its initial setting. Adjust the display for 8 centimeters of vertical deflection. Reset X VOLTS/CM switch to its original setting; recenter the display, and read dimension A in Figure 3-3.

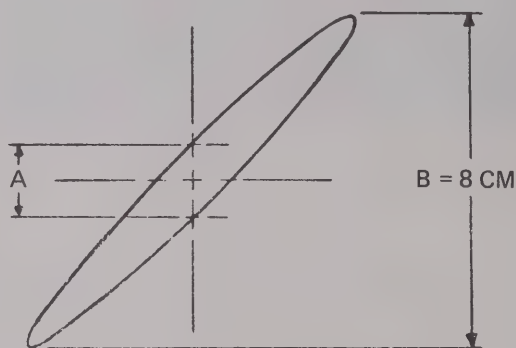


Figure 3-3. Phase Shift Measurements

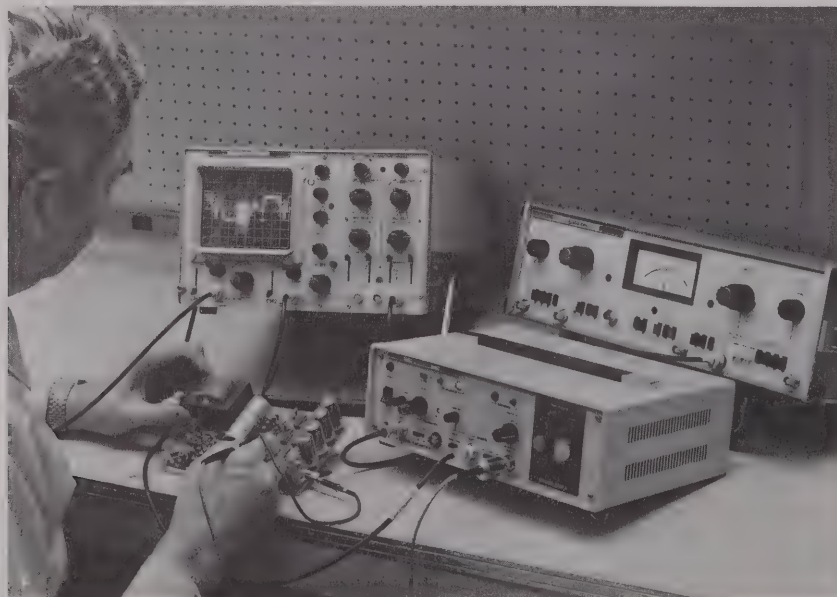


Figure 3-4. Typical Setup Using 7050A Electronic Signal Recorder

Principles of Operation

4-1. GENERAL

Referring to the block diagram (Fig. 4-1) signals applied to the CH1 and CH2 input connectors pass into their respective attenuators and amplifiers. The VOLTS/CM switch controls the gain of the amplifier in the necessary 1, 2, 5 sequence to cover the ranges from 5 mV/cm to 0.2V/cm. Above this a $\div 100$ attenuator is introduced before the amplifier.

The fast electronic beam switch selects either the CH1 or the CH2 signal to be amplified further and passed to the Y deflection plates of the CRT.

A sample of each signal is taken and passed to the trigger switch, where selection of CH1, CH2 or Ext trig source is made. The selected signal is amplified and passed to the Schmitt trigger, where it is converted into fast negative-going pulses. The hold off circuit acts as a gate which is normally open to allow a trigger pulse to set the timebase bistable. The bootstrap ramp generator then begins to gener-

ate its linear ramp, which after passing through the X amplifier is applied to the cathode ray tube and drives the electron beam linearly across the tube face. A small portion of the signal from the ramp generator is fed back to the hold off circuit, shutting the gate to prevent any further pulses from the Schmitt trigger from reaching the timebase bistable during the ramp period. When the ramp has reached the necessary maximum level, the timebase bistable is reset, and the ramp is quickly returned to its quiescent state. A time constant in the hold off circuit now holds the gate closed to inhibit another ramp from being initiated for a short period, until the ramp timing capacitor is discharged fully. Thus a ramp is generated at a rate set by the TIME/CM switch when the trigger signal reaches a predetermined level. This ramp sweeps the beam across the CRT face, returns and waits for the next trigger point to be reached. The timebase bistable is connected to a blanking amplifier whose function is to turn on the electron beam during the sweep and blank it off during the fly back and subsequent waiting period.

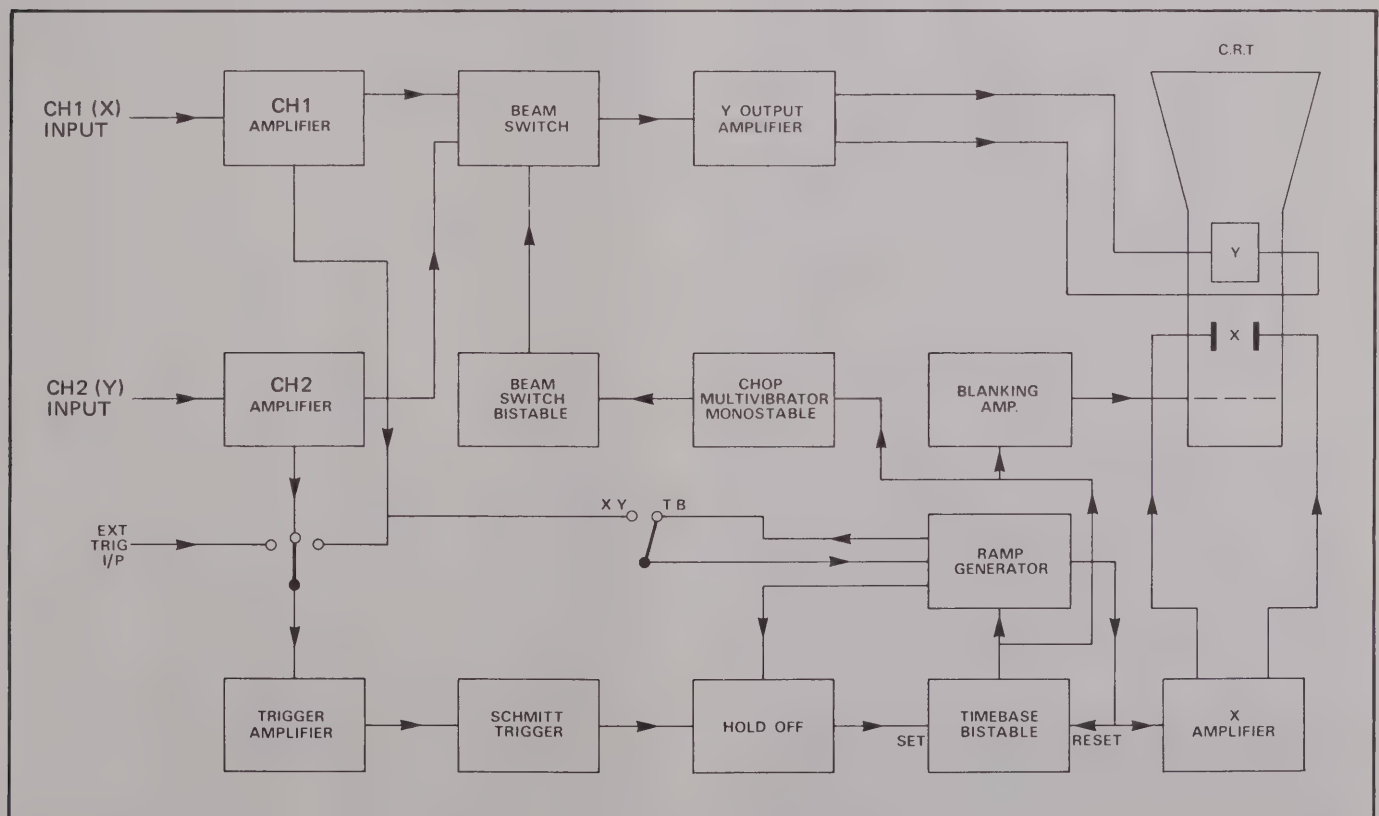


Figure 4-1. Block Diagram

At fast sweep rates for a dual trace display, the TIME/CM switch automatically selects the alternate sweep mode of control for the beam switch. At the end of each sweep the signal from the timebase bistable reverses the state of the beam switch bistable, causing alternate displays of the CH1 and CH2 signal on successive sweeps of the timebase. At slow sweep rates, the chop mode is selected. When the chop multivibrator free runs independently, it causes the beam to switch between CH1 and CH2 levels during the sweep. A signal from the multivibrator also blanks the trace during each switching transition. With CH1 or CH2 switched to the OFF position the beam switch bistable is locked to switch on the other channel.

In the X–Y mode, the signal from the CH1 amplifier, normally used for trigger, is passed via the ramp generator, which acts as a voltage follower, to drive the X plates while the beam switch selects CH2 to drive the Y plates. The beam blanking signal is not used and the CRT beam is on continuously.

4-2. THE Y AMPLIFIERS

The attenuator and pre-amplifier in CH1 are identical to those in the CH2. Accordingly, only CH1 is described.

The input signal is applied to the front panel BNC SKA and then to the 3 position slide switch S20, via R26. The switch selects AC or DC input coupling by including or by-passing C21 in the signal path. In the middle position of the switch, the input BNC is disconnected, and the input of the attenuator is connected to ground through R27. The attenuator feeds into an impedance of $1\text{ M}\Omega$ (R29). The $\div 100$ attenuation is determined by the potential divider action of R20 in series with the parallel combination of R29 and R201. High frequency compensation of the attenuator is achieved by the AC potential divider C202 and C203; C202 is set for the correct ratio. C201 is adjusted to maintain constant input capacitance between divided and undivided ranges. This attenuator is used on the six higher voltage ranges i.e. 0.5V/cm – 20V/cm , dividing them down to $5\text{--}200\text{mV/cm}$. Further selection of input sensitivity is carried out by gain switching within the amplifier, and is described later. Diodes D201 and D202 in conjunction with R28 protect the input up to 400 volts peak.

The input stage consists of TR201 and TR202, a matched pair of field effect transistors. The current in TR202 is self biased such that the potential drop across R205 equals the gate/source potential. This same current flows in TR201, which operates as a source follower on the input signal. As R207 equals R205 the base potential of TR203 always equals the input voltage on the gate of TR201. The signal is passed via emitter follower TR203 to the gain switching stage.

The grounded emitter transistor TR304 forms a shunt feedback amplifier with gain determined by the ratio of the feedback resistor R211 to the input resistor R40 in parallel with the resistor selected by the range switch as shown in Table 1. R202 (BALANCE) sets the base of TR203 to null the potential across R40 etc.

The signal from the collector of TR204 is passed via R214 to the base of TR205 which in conjunction with TR206 forms a long tail pair amplifier, the gain of which is set by R217 and R223. The collector current of TR205 feeds into the trigger section of the timebase and 'X' amplifier circuit. Potentiometer R52 provides a variable current via R219 into the collector circuit of TR206, to produce 'Y' positioning. The bases of TR206 (CH1) and TR216 (CH2) are driven from the collector circuit of TR217 which being connected in a similar manner to TR204 and TR214 provides the correct bias and compensation for supply and temperature variations.

The beam switch, consists of diodes D203, D204, D206 and D207, with their associated drive circuitry and is described in detail in section 4-3. It selects the collector current of TR206 or of TR216 to pass through D205 and R223. The voltage developed across R223 consists of a fixed d.c. component, a variable d.c. component (Y positioning) and the signal and is applied to the base of TR207, a common emitter amplifier. The emitter circuit includes potentiometer R222, to set the gain of the stage and hence the overall gain of the Y amplifier. The signal from the collector of TR207 is passed to the base of TR208, which with TR209, TR210 and TR211 forms the output cascode stage. TR208 and TR209, is a differential amplifier which converts the input signal voltage to differential output current, its gain is determined by emitter resistors R234 and R236, with high frequency gain set by networks R232/C211/C212, R233/C213 and R236/C236. The collector currents of TR208 and TR209 flow into the emitters of the grounded based transistors TR210 and TR211 to develop the differential output voltage across the load resistors R230/R240 to drive the CRT deflection plates. Inductors L201 and L202 are included to improve the high frequency response.

Switch Setting	Attenuation	Resistor Used	Amplifier Gain
5mV	$\div 1$	R40+R45	5
10mV	$\div 1$	R40+R44	2.5
20mV	$\div 1$	R40+R43	1.25
50mV	$\div 1$	R40+R42	0.5
100mV	$\div 1$	R40+R41	0.25
200mV	$\div 1$	R40 only	0.125
500mV	$\div 100$	R40+R45	5
1V	$\div 100$	R40+R44	2.5
2V	$\div 100$	R40+R43	1.25
5V	$\div 100$	R40+R42	0.5
10V	$\div 100$	R40+R41	0.25
20V	$\div 100$	R40+ only	0.125

4-3. THE BEAM SWITCH

The emitter of D203 is supplied with a 6 volt positive-going square wave from the multivibrator TR218/TR219. When the waveform is "high", D203 is biased off and the collector current of TR206 passes through D204 into the output amplifier. During the low state of the waveform D203 conducts, passing this current to ground through TR219. As diodes D203 and D207 are fed with complementary waveforms, when the current from TR206 passes to the output amplifier, that from TR216 is shunted to ground and vice-versa.

Bistable TR218/TR219 is switched with pulses from TR220/TR221, the chop multivibrator.

This emitter coupled circuit free runs at approx. 500kHz on TIME/CM settings from 0.5s to 1ms, causing the bistable to operate the beam switch at 250kHz. In addition to driving the bistable, an output from the collector of TR221 is fed to the cathode of the CRT to blank the trace during the beam switching transitions. The mark/space ratio of the multivibrator is approx. 1:4, causing the trace to be blanked for one fifth of each switching period.

At faster TIME/CM settings of 0.5ms to 1 μ s, the lower end of R292 is taken to -20V by a contact on the timebase switch biasing off TR221, and preventing oscillation. The circuit now acts as a monostable, triggered via C220 at the end of each sweep by pulses from the timebase bistable, each output pulse reversing the beam switch bistable and rapidly blanking the trace.

For single trace operation, the Y position control on the channel not required is rotated fully counter clockwise to operate the OFF switch. In this position, the switch S27 or S28 is closed, connecting the cathode of its associated diode to the negative line. This biases off the relevant transistor in the multi. Thus when CH1 is turned off, S27 closes, biasing off TR218; TR219 turns on and sinks the current from CH2 to ground through D203. A versal occurs when CH2 is turned off. In the X-Y mode, both shift controls are set to the on position; a contact on the TIME/CM switch in parallel with S27 is used to bias TR218 off, allowing CH2 signals only to reach the Y output stage.

4-4. THE TRIGGER CIRCUITS

The collector currents from TR205 and TR215 in the Y amplifier pass to the timebase printed circuit board into R108 and R109 respectively. In series with R108 is R110 shunted by C101, a collector load network used when X-Y mode is selected. External trigger signals appear across R107, and these, together with those across R108 and R109 pass to the trigger selector switch. The selected trigger signal is amplified by TR107 and passed to the coupling switch. Here, high pass, direct and low pass networks provide the required ACF-AC-TVF filtering. Trigger level and slope selection operations are performed by differential amplifier TR101/TR102. The signal is applied to either input as determined by the slope selector switch, the other input being grounded via C121. The Trigger Level control, R10, provides a variable d.c. bias at both inputs, which the am-

plifier sums with the signal. The output at the collector of TR102, consisting of an alternating signal voltage superimposed on a d.c. level, passes to the Schmitt Trigger TR103/TR104, where fast negative edges are generated as the input signal crosses the circuit threshold.

4-5. THE TIMEBASE BISTABLE MULTI AND RAMP GENERATOR

The ramp generator comprises TR111, TR112 and TR113 as cascaded emitter follower stages, with bootstrap feedback action provided from the cathode of Zener diode D104. This feedback maintains constant voltage across the VARIABLE TIME control R11, R148, R147 and the timing resistor selected by the TIME/CM switch. This constant voltage drop, independent of actual voltage level produces a constant current to linearly charge the timing capacitor, also selected by the TIME/CM switch. The VARIABLE TIME control provides fine adjustment of the timing current, and hence sweep time, by varying the feedback voltage applied to the timing resistor.

In the quiescent condition of the timebase bistable, TR108 is on, TR109 is off and clamp transistor TR110, which shunts the timing capacitor, is saturated. A negative-going pulse from the Schmitt Trigger is coupled via C111 and D102 to turn off TR108. TR109 turns on, thus turning off TR110. The clamp is removed, allowing the timing capacitor to charge, producing the linear ramp. As the emitter of TR113 rises, a feedback voltage, via D105, R143 and R133 biases off D102 to prevent any further pulses from reaching the bistable. Connected to the junction of R133 and R143 is the HOLD OFF capacitor which now charges positive. When the ramp reaches its final amplitude, a rise of approximately 10V, feedback from the junction of R151/R149 is applied to the base of TR108, turning it on. The bistable reverts to its initial state allowing TR110 to turn on, rapidly discharging the timing capacitor and returning the ramp to its quiescent level. The hold off capacitor, which was charged to a positive voltage during the ramp, now slowly discharges through R143 and R153, until it is caught by D105. Only then is D102 biased for the next trigger pulse to initiate the next sweep.

An output is taken from the ramp generator via R155 to SKE, the RAMP OUT jack on the front panel.

4-6. BRIGHT LINE AUTO CIRCUIT

When sufficient trigger signal is available, the square wave from the collector of TR104 passes through R127/C104, where restoration by D101 produces a negative going signal with respect to the negative rail. This negative signal on the base of TR105 is integrated by R124/C107 to produce a d.c. bias sufficient to hold off TR106. In this condition the circuit has no effect on timebase operation. However, when the triggering signal falls below the required level, the Schmitt trigger ceases to operate, removing the signal from D101. The voltage on the emitter of TR105 rises to approximately one volt above the negative line, turning on TR106. R177 is now effectively connected between the negative rail and the cathode of D102. It rapidly discharges the hold off

capacitor below the normal quiescent level to a point where D102 conducts, turning TR108 off and initiating a sweep. At the end of the ramp, the charge on the hold off capacitor is again removed by R177/R143 and another ramp begins. These consecutive sweeps produce the bright line display. When the level control is PULLED to manual mode switch S10 closes, effectively shorting the base and emitter of TR106, holding it off, in this condition a sweep is only generated after the arrival of a trigger pulse.

4-7. THE X OUTPUT AMPLIFIER

The ramp or X-Y signal at the emitter of TR113 passes through R156 to the base of TR114, which with TR117 forms a long tail pair. Gain switching is carried out in the emitter circuit by selection of one of two resistance paths with gains set by R169 (X1) and R16/R162 (X10). In time-base mode, the PULL X10 switch S11 can be operated in order to expand the trace length ten times. In the X-Y mode contacts on the TIME/CM switch, is parallel with S11, close to select this higher gain setting automatically. An X POSITION voltage is produced at the base of TR117 by R12. The signals on the collectors of TR111 and TR117 are applied to the differential output amplifier. TR115 and TR116. Signals from the collectors of these two transistors drive the horizontal deflection plates of the CRT.

4-8. X-Y MODE

In this mode, signals are applied to both CH1 and CH2 input connectors; CH2 is routed through the beam switch to the Y deflection plates in the normal manner. CH1 is routed through the ramp generator, now acting as a high impedance unity gain buffer, and into the X output stage.

Signals entering CH1 pass through the attenuator and gain switching stage, as described previously. Current from TR105 passes to the X board, while that in TR206 is shunted to ground through D203. The current from TR205 develops a voltage across the series connection of R110, R108. This voltage is level-shifted by R144/R146 to the base of TR111. In the X-Y mode, both timing resistors and capacitors are switched out of circuit consequently TR111, TR112 and TR113 merely act as emitter followers which provide buffering between the level-shift resistors and the X output amplifier.

When this mode is selected, a contact on the TIME/CM S14 (a) switch connects the cathodes of D106 and D107 to the negative line. The current drawn through D106 and R138 turns off TR108 and consequently TR110, and removes blanking. (see section 4-11)

Current through D107 controls the state of the beam switch bistable multi. (see section 4-4)

4-9. POWER SUPPLIES

All power supplies are derived from transformer T1. The primary winding can be connected to accept six supply voltage ranges,

The transformer secondary has four windings developing the following r.m.s. voltages; 6.3V, 44V (center tapped), 140V and 1000V.

The 6.3V winding supplies the CRT heater which sits -1.3kV d.c. off ground.

The 44V a.c. is rectified by MR32 and filtered by C33/C34 to form the unregulated +26V and -26V d.c. lines. These voltages are fed to series regulators to provide the regulated +20V and -20V lines. As both regulators operate in an identical manner, only one will be described.

The base of series pass transistor, TR32, is fed from the output of the high gain error amplifier formed by TR305/TR306. This amplifier compares the zener reference voltage from D316 with the voltage at the junction of R310/311, a potential divider connected between the emitter of TR32 and ground. As this emitter supplies the +20V line, any fluctuations in the line voltage appear at the base of TR306 where they are amplified and inverted. This signal is then fed to the base of TR32 to correct the error, thus maintaining a constant output voltage. Resistor R309, in series with the collector of TR32, drops a voltage which is proportional to the output current. Under normal conditions, this voltage drop is less than that across R307, biasing off D310. As the output current rises above the safe maximum, D310 turns on, taking the current in R307 away from the emitter of TR305. This causes a drop in voltage at the collector of TR306 and hence on the base and emitter of TR32, limiting the current to a safe value.

The voltage from the 140V winding is rectified by MR31 and filtered by C31 to provide the unregulated 170V supply.

The 1000V winding energizes both the -1.2kV and +2.4kV supplies. Half wave rectification of the negative half cycle by D301 produces the negative line, while voltage doubling by D302/D303 produces the positive. Regulation of both lines against supply variation is achieved as follows. One end of the 1000V winding feeds the diodes mentioned above. The other end passes to ground through bridge rectifier MR301. The alternating current in the winding passes through the rectifier as direct current via R338 and TR301, developing a filtered direct voltage across C315. This voltage, controlled by the conduction of TR301, forms a threshold above which the alternating voltage applied to the bridge must rise before current can flow. As this threshold must be reached on both positive and negative excursions of the supply waveform, the overall effect is to take the middle out of the sine wave, thus reducing its voltage. This controlled voltage is rectified to produce the E.H.T. supplies. R322 feeds a negative current into the base of TR302, proportion to the peak value of the regulated waveform. This current is balanced by a reference current from the + line fed via R319 and SET E.H.T. potentiometer R320.

The voltage at the summing point of the two currents appears at the emitter of TR302 and controls the current flow through D304, which in turn controls the conduction of TR301. As it is this conduction which controls the alternating voltage from which the feedback is derived, a

closed loop circuit is formed. Variations in the magnitude of voltage across the 1000V winding either increases or decreases the voltage on the -1.2kV line. Feedback from this line is compared with a reference and the conduction of TR301 is varied accordingly to bring the line back to its correct voltage. As the $+2.4\text{kV}$ line is derived from the same regulated source as the -1.2kV , it also remains constant.

4-10. CALIBRATOR

The $1\text{V} \pm 2\%$ square wave at the CAL 1V jack, SKD, is produced by TR307, on the power supply board. Current for the base of this transistor is supplied via R305 and D311. The anode of D312, is connected to the junction of these two components, its cathode being taken to one of the 22V windings. On positive excursions of the winding, D312 is biased off, and the current through R305, D311 saturates TR307. During negative excursions, D312 conducts, and the current in R305 passes through the transformer winding. In this condition D311 and TR307 are turned off. The result is a square wave on the collector of TR307, at line frequency, with amplitude set by adjustment of R304.

4-11. BLANKING

The signal which blanks the CRT when a sweep is not occurring is produced by TR308. The base of this transistor is fed via R135/C118 from the collector of TR108 in the timebase bistable. When TR108 is on, no current flows in R135, thus TR308 is off and its collector is at approximately 70V, as determined by R335, R336 and R337. This voltage is fed to the beam blanking plates of the CRT, pin 5, and blanks the trace. As TR108 turns off to initiate a sweep, the current in R135 turns TR308 on; its collector voltage falls

to about 3V, where it is held by the action of the forward biased diode, D313. Under this condition CRT blanking is removed. Blanking is not effected in the X-Y mode as TR108 in the timebase bistable multi is permanently turned off.

When dual trace operation is selected, a pulse is coupled via C314, from the collector of TR221 into the cathode of the CRT in order to blank the trace during the channel switching transition.

Z Modulation

Signals applied to SKF on the rear panel pass via C313 to the grid of the CRT where they produce trace intensity modulation.

4-12. CRT NETWORK

The cathode of the CRT draws current from the -1.2kV line through the Intensity control, R33. Clockwise rotation of this control decreases the grid potential, and hence varies the tube conduction from cut off to maximum. Electrons emitted from the cathode are focussed into a narrow beam by potentials on the focus and astigmatism electrodes. These potentials are approximately -850V and $+80\text{V}$, controlled by R34 and R332 respectively.

When a positive potential is applied to the blanking plates, the electron beam is deflected to one side of the tube, thus preventing the electrons striking the tube face. The geometry control R333 varies the potential on an electrostatic shield placed between the X and Y deflector plates to minimize interaction. After deflection by the X and Y plates, the electron beam is accelerated by the PDA potential of $+2.4\text{kV}$, to strike the phosphor coated tube face at high velocity, and produce the display.

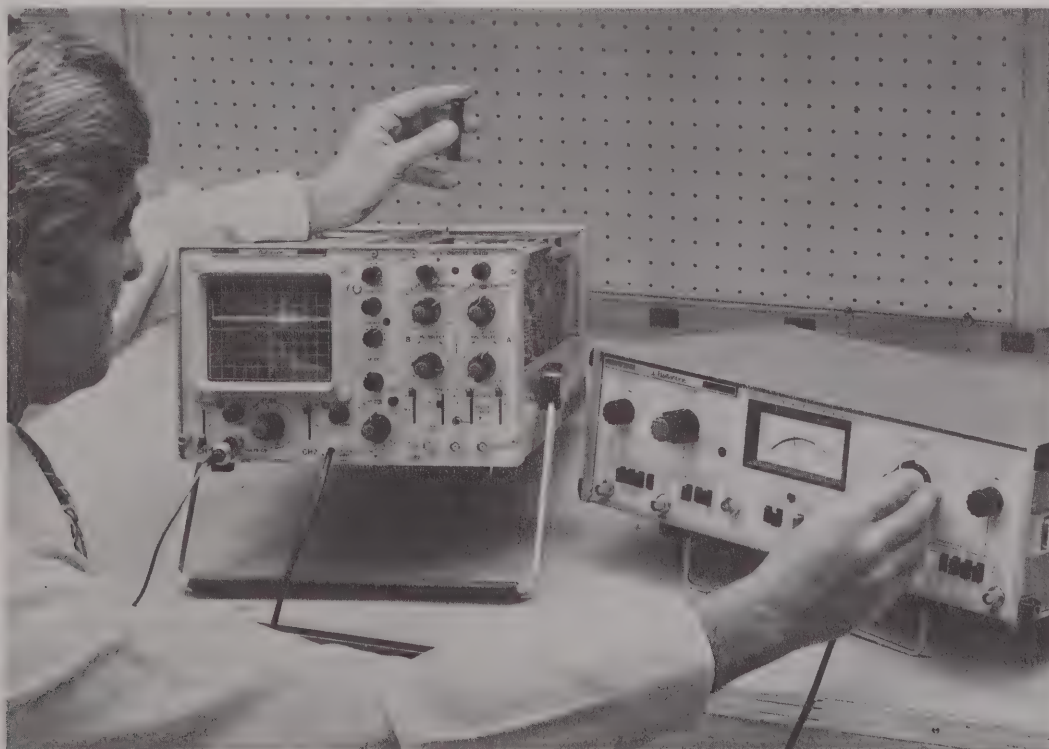


Figure 4-2. Scope Adjustment Using 6125A Oscilloscope Calibrator

Section 5

Maintenance

5-1. GENERAL

Figs. 7 and 8 show the internal location of sub assemblies and preset controls. Access to all preset controls and most other components is obtained by removing the top and bottom covers. Full access to all components can be achieved by removing the Y amplifier sub assembly or timebase and X amplifier sub assembly.

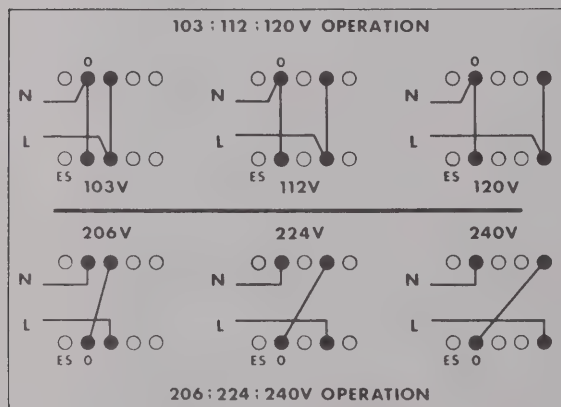
For details fault finding the instrument can be operated with either assembly out of the frame and with the inter-connecting leads extended.

(a) Removal of Covers

Each cover is retained in position by four latch fasteners. Each fastener is released by turning it one quarter of a turn counter-clockwise.

(b) Transformer Tap Connections

DISCONNECT THE INSTRUMENT FROM THE SUPPLY BEFORE ADJUSTING THE TRANSFORMER TAPS. The transformer tap connections for each of the normal supply voltages are shown below. It will be seen that the two tapped primary windings are connected in series or parallel as necessary. The 'line' is the brown lead from the fuse and the 'neutral' is blue. The ground wire from the power card is tied to chassis.



(c) Fuse Replacement

DISCONNECT THE INSTRUMENT FROM THE SUPPLY BEFORE CHANGING THE FUSE. The 500mA slow blow fuse is mounted on the inside of the rear panel, above the transformer.

5-2. REMOVAL OF SUB-ASSEMBLIES

Removal procedures for each of the Printed Circuit Board assemblies are outlined below. However, almost all the components in the instrument, with the exception of those in the early stages of the Y amplifiers, are accessible without recourse to board removal.

(a) Y Amplifier Sub-assembly.

1. Remove and identify the leads from pins 9, 10, 11, 12, 13, 16, 17, 21, 23, 25 and 29 on the above named assembly.
2. Remove and identify the leads from pins 5 and 41 on the time base board.
3. Remove the two screws holding the heat sink plate to the side bar of the instrument, and remove the screw from the rear of the assembly.
4. Remove the knobs from both CH1 and CH2 attenuator switches and position controls.
5. Remove the switches nuts from the bushings of the attenuator switches.
6. The assembly can now be removed. With the assembly out of the instrument, the attenuator shields can be released by removal of four screws.

(b) Timebase and X Amp Sub-assembly

1. Remove and identify leads from pins 21, 23 and 25 on Y amp board.
2. Remove and identify leads to pins 5, 10, 11, 26, 33, 41, 43, 44, 45 and 46.
3. Remove two screws at rear of assembly.
4. Remove the knobs from VARIABLE TIME, X SHIFT and TRIG LEVEL controls, from TIME/CM and TRIG SELECT switches.
5. Remove nuts from TIME/CM and TRIG SELECT switches.
6. The assembly can now be removed.

(c) CRT Replacement

CAUTION

The CRT is a high vacuum tube. Use extreme care. Do not scratch or mar the glass. Use gloves and wear safety goggles whenever handling the CRT.

1. Remove the tube base connector.
2. Remove the P.D.A. cap from the CRT
3. Remove lead from pin 21 on power supply board.
4. Remove screw holding tube shield to the tube support clamp and the two screws from tube clamp. Loosen the CRT face mounting screws and bushings.

5. Slide the tube and tube shield back to clear the front panel mountings and remove the tube and shield from the instrument. The tube can then be withdrawn from the shield.
6. Replace the tube in the reverse order.

When the tube is replaced it may require rotation to align the trace with the graticule (see section 5-4d)

5-3. FAULT FINDING

Before any fault location is attempted, it is suggested that all supply line voltages are checked with respect to chassis ground.

LINE	MEASURED VOLTAGE	
+20V	+19 to +21V	
-20V	-10 to -21V	
+170V	+160 to +180V	
PDA	> +1,900V	Use meter at least
*-1.2kV	-1,140 to -1,240V	20,000Ω/V.

*Measured at junction R322, R324

CAUTION

Attach meter to circuit with instrument turned off to avoid contacting high voltages. Use caution whenever working on voltages above 30 volts.

NOTE

The power supply input voltage should be approximately at the middle of the range for which the transformer taps are connected.

Table 3, indicating voltages at various circuit locations, may be used as a general guide and servicing aid. The front panel controls should be set as follows:

INTENSITY	— at mid position
Y POSITION	— at mid position
CH2 POSITION	— at mid position
CH1 POSITION	— to CH2 OFF position
TRIG SELECT	— to CH1 +
ACF, AC, TVF	— to A.C.
LEVEL	— to mid position, BRIGHT LINE on.
TIME/CM	— to X—Y

Adjust X and CH2 position controls to bring spot to center of tube.

If a fault on a printed circuit board cannot be cleared it is recommended that the instrument is returned to Ballantine or a fully equipped service shop for repair. When faults have been cleared it is recommended that the full calibration procedure is followed. Calibration adjustments should be made only after a 15 minute warm up period after turning the oscilloscope ON.

LOCATION	TYPICAL VOLTAGE
Y Amplifier Sub-assembly	
Base TR203, TR222	0V
Collector TR204, TR214, TR217	+7V
Pin 22	+3.6V
Pin 21	+3V
Collector TR207	+9.3V
Pins 9 and 10	+110V
Emitter TR221	12V
X Amplifier & Timebase Sub-assembly	
Collector TR107	+4V
Collector TR102	+13V
Collector TR106	-20V
Collector TR109	+0.1V
Emitter TR113	+5.5V
Emitter TR115, TR116	-6.8V
Pins 34, 37	+92V
Power Supply Sub-assembly	
Emitter TR302	+0.5V
Collector TR308	+3.5V

5-4. CALIBRATION PROCEDURE

(a) **Test Equipment** (See Table 5-1)

(b) **Power Supply Voltages**

With the transformer connected for 111 to 130V operation, connect the instrument to the A.C. supply via a variable autotransformer, and set the voltage to 120V ±1%. If the supply transformer is not connected for 111 to 130V operation, the test should be carried out with the supply within 1% of the nominal voltage.

Check the voltages to chassis on the following pins on the power supply board:

+20V	+19.0V min.	+21.0V max
-20V	-10.0V min	-21.0V max
+170V	+160V min	+180V max
PDA	> +1900V	

Adjust R320 (EHT) to give 155V across C315. Unless the instrument is supplied from a known stable source, the supply voltage should be checked at the same time that the potential across C315 is measured. Measure the voltage from the junction of R322, R324 to chassis which should be between -1140 to -1240V. This voltage should not change by more than ±9V when the supply voltage is varied from 111V to 130V. Use caution when measuring the high voltage.

(c) **Astigmatism**

Set the front panel controls as follows: TIME/CM switch to X—Y, INTENSITY to mid position, X position to mid range, CH1 and CH2 position controls to mid range and CH1 and CH2 VOLTS/CM switch to 2. Adjust X and CH2 position to center a spot on the screen. Adjust R332 (Astig) together with the INTENSITY and FOCUS controls to obtain a sharp round spot.

Table 5-1. Test Equipment

REQUIREMENT	INSTRUMENT OR EQUIVALENT
1. Oscilloscope Calibrator	Ballantine 6125A
a) Voltage 30 mV to 300 V $\pm 1/4\%$ 1 kHz squarewave	
b) Time Mark Generator 0.5 μ s to 5 sec. $\pm 0.02\%$ Sine Wave 20ns and 50ns	
c) Fast Rise Square Wave Generator 1MHz, 100kHz, 10kHz, 1 sec Nominally 250mV into 50 Ω Risetime < 1 ns Flattop, minimum perturbations	
d) Line Frequency Sine Wave Line Frequency, filtered 10mV to 1 Volt uncalibrated	
2. Multimeter Volts AC/DC, 0-2.5 μ V AMPS AC/DC Ohms, Input $> 20,000\Omega$ /Volt 5% Accuracy	Ballantine 3/24 or Simpson 260
3. A.C. True RMS Voltmeter 1 mV to 300V rms 2% Accuracy to 100kHz) 2Hz to 20MHz	Ballantine 323L
4. Variable Auto Transformer 95 to 135 Volts	General Radio W5MT3AW
5. Sine Wave Generator, Constant Amplitude 0.1 to 2.5 volt p-p 50 kHz to 50 MHz Flatness $\pm 3\%$	Tektronix 190/191
6. Alignment tool, Insulated	JFD 5284
7. 50 Ω Termination BNC/BNC – 3% 1 Watt	Ballantine 12630A
8. Resistor 215 kohm $1/4$ W 1% Film	Ballantine 12-12232-OA
9. Capacitance standardizer 28 pF – shielded High Impedance frequency compensated attenuator with BNC Connectors giving 2X attenuation when used with 1M Ω 28 pF load. Accuracy within 5% to 100kHz	Ballantine 10650A
10. Attenuator, 50 Ω , 20dB ± 0.3 dB Flat dc to > 100 MHz GR 874 to BNC Adapters (2)	General Radio 874-G20
11. Cable, BNC/BNC, RG58A/U, 120 cm, (4 ft.) 20 cm, (8 inches),	Ballantine 12249D Ballantine 12249A
12. Cable, BNC/Alligator clips 120 cm, (4 ft.)	Ballantine 12250D
13. TV Video Waveform Generator	Optional

(d) **Trace Rotation**

Set the TIME/CM to 1ms/cm and bright line auto on. Rotate the CRT to bring the trace exactly parallel with the horizontal graticule line. It may be necessary to loosen the CRT face support screws to rotate the CRT.

CAUTION

Use gloves and safety glasses when handling the CRT.

Tighten all screws after rotating CRT.

(e) **Geometry**

Set the CH2 position to OFF, CH1 input switch to A.C., Trigger Selector to CH1 and TIME/CM to 1 μ s. Apply a 1kHz sinewave to the CH1 input BNC. Set the sine wave amplitude to give approximately 8cm of Y deflection. Set the TIME/CM switch and LEVEL control so that approximately 10 cycles are displayed. Adjust R333 (Geom) for a compromise between horizontal and vertical pin-cushioning and barrelling effects. Reset the FOCUS, and if necessary adjust R332 (Astig).

(f) **DC Balance**

Set the CH1 and CH2 input switches to ground. Adjust the CH1 and CH2 BAL controls to eliminate X and Y trace movement when CH1 and CH2 VOLTS/CM are switched from 0.2V/cm to 5mV/cm.

(g) **Timebase Calibration** (Use 6125A Calibrator)

Switch TIME/CM to 1ms/cm, variable time in CAL position. Apply 1ms markers to CH1 input, adjusting Y sensitivity to give approximately 2cm amplitude and triggering without bright line auto. Adjust R169 (X1 Gain) for 1 pulse/cm. Set X10 switch on, change markers to 0.1ms/cm and adjust R162 (X10 Gain) for 1 pulse/cm. Switch X10 off and set TIME/CM to 10 μ s/cm. Change markers to 10 μ s and adjust C10 for 1 pulse/cm. Check the timebase accuracy on all ranges to specification. Check that the variable time control reduces the speed by greater than 2.5:1. Ensure that the trace length is greater than 10cm on all ranges. With 10X MAG on apply time markers and check that the speed accuracy is within specification on all ranges ($\pm 5\%$) ignoring the non-linearity on the first 5cm of the 0.1 μ s/cm. range. Switch off the X10 MAGnifier.

(h) **Y AMP Calibration**

Set both CH1 and CH2 attenuators to 0.2V/cm, both input switches to DC, and the TIME/CM to 5ms/cm. Apply 1V square wave (0.2V X5) from the calibrator to CH1 and adjust R222 (Y Gain) for a 5cm display. Apply the same signal to CH2 input, trigger on CH2 and observe the deflection. Readjust R222 to equalise the errors from 5cm deflection between CH1 and CH2. Error must be $< 5\%$ on any attenuator step for both channels.

(i) **Input Capacity and Attenuator Compensation**

Capacitors C25 and C27 are selected such that the input capacitance is approximately 28pF.

To set the attenuator compensation, set the CH1 VOLTS/CM switch to 0.5, the input coupling to D.C. and the TIME/CM to 0.5ms. Connect a low impedance 3V, 1kHz square wave signal to the input and adjust C202 for a square top to the display.

Repeat for CH2, adjusting C222.

To equalise the input capacitance on all ranges, set the Y1 VOLTS/CM switch to 0.2, the input coupling to DC and the TIME/CM to 0.5ms. Use a Ballantine 10650A capacitance standardizer or connect a 1kHz square wave signal through a 10:1 probe. Set the input amplitude for approximately 6cm of display and adjust the standardizer compensation or the probe for a square top to the display. Set the CH1 VOLTS/CM switch to 0.5 and adjust C201 to regain the flat top to the display.

Repeat for CH2 adjusting C221 without readjusting the standardizer or probe.

(j) **Internal Calibrator** (Use 6125A Calibrator)

Set CH1 attenuator to 0.2V/cm then apply to CH1 input a 1V $\pm 1\%$ squarewave from the amplitude calibrator and note the exact deflection. Remove the 1V squarewave and apply the internal calibrator to CH1 input. Adjust R304 (Cal) to give the deflection previously noted.

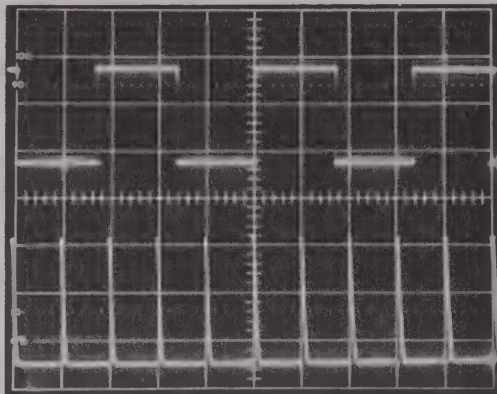
(k) **Trigger Sensitivity**

Apply the CAL signal to the CH1 input, set to 5V/cm with TRIGGER set to CH1 and AC with AUTO off (Pull). Rotation of the LEVEL control should give a stable display of the correct slope in both + and – positions. Check that timebase does not free run at any setting of the LEVEL control. Push the LEVEL control in for Auto mode. Rotation of the LEVEL control should show range with a stable display of the correct slope in both + and – positions *but free running outside this range*. Remove the calibrator from the CH1 input and set this input to GROUND. Check that the timebase free runs at all settings of the LEVEL control in both + and – positions.

Repeat for CH2.

(l) **ACF AND TV Trigger**

Set CH2 attenuator to 1V/cm connect the internal calibrator and select ACF. Two stable trigger points of opposite slope should be found in the level control. Switch to TV, CH2+ and apply to CH2 input a composite video waveform from a video waveform generator or a TV receiver. Adjust CH2 attenuator to give 1 to 2cm display. Adjustment of the TRIGGER LEVEL control should give a stable display triggered from a video frame pulse. Remove the video input and return TRIGGER coupling switch to A.C.



5 ms/cm
Line Frequency (60 Hz = 16.67 ms)
CAL 1 V jack on panel
(See Note Below)

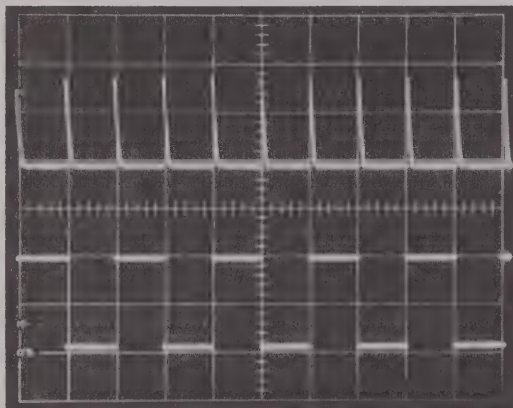
Time Mark Generator
5 ms and 50 μ s marks
(Note Calibration Linearity)

NOTE:

On 50 Hz power supply input period of calibration square wave is 20 ms

With time base set to 5 ms/cm check for 2 1/2 cycles full scale.

Figure 5-1. Horizontal Time Calibration



1 ms time markers

Amplitude Calibrating Square Wave

Fast Rise Time

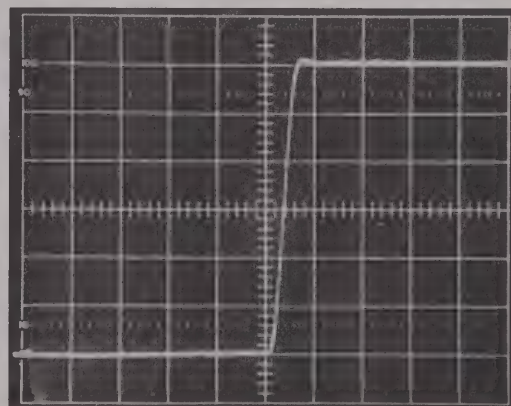


Figure 5-2. Ballantine 6125A Calibrator Waveforms

(m) EXT Trig

With internal CAL signal applied to the CH2 input, the CH2 attenuator set to 5V/cm, and trig selector set to EXT, apply the CAL waveform also to the EXT trig BNC via a 215k Ω resistor. Check that the instrument LEVELS and triggers correctly with AUTO mode both on and off.

(n) Pulse Response (Use 6125A Calibrator)

Switch the CH1 attenuator to 5mV/cm and set TIME/CM to 1 μ s/cm. Apply a 100kHz fast (<1 ns) risetime square wave signal to CH2 input using a 50 Ω termination at the input BNC to prevent cable reflections. Adjust output amplitude from the calibrator to give 6cm display. Adjust C211 to extend the flat top towards the leading edge. Adjust C209 for a square corner. Apply the fast rise signal to CH2 to check the squareness of corner, then readjust C211 and C209 as necessary for a compromise square corner between CH1 and CH2 amplifiers. Check that the pulse response is square on all ranges between 5mV/cm and 0.2V/cm, adjusting the signal amplitude for 5cm on each range, to 50mV/cm and to maximum amplitude permitted by the 6125A calibrator when 50 Ω BNC termination is removed on the 0.1V and 0.2V/cm ranges, both CH1 and CH2 allowing a maximum of 4 percent overshoot or undershoot.

(o) Bandwidth

Set CH1 attenuator to 5mV/cm and apply the output of a constant amplitude generator to the CH2 input. Set frequency to 50kHz and adjust generator output to give 6cm display. Increase the frequency until amplitude falls to 4.2cm. This frequency should be greater than 10MHz. Repeat for CH2.

(p) HF Trigger

Switch off the AUTO Trigger Mode. With the constant amplitude generator applied to the CH2 input and the TIME/CM set to 1 μ s/cm, X10, set the generator frequency to 10MHz and adjust the output to give 1cm display. It should be possible to obtain a cleanly triggered waveform by adjustment of the level control. Repeat for the CH1.

(q) X-Y Operation (Use 6125A Calibrator)

Switch the TIME/CM to X-Y and both CH1 and CH2 attenuators to 0.2V/cm. Apply a 4V (.05V x8) 1kHz squarewave signal to the CH1 input BNC. The X deflection should be 8cm $\pm$ 5%. Apply 50kHz from the Constant Amplitude Generator to the CH1 input and GROUND the CH2 input. Adjust the generator to give a 10cm horizontal line.

Increase frequency until the line reduces to 7cm. This frequency should be greater than 500kHz.

(r) Z Mod (Use 6125A Calibrator)

Set the CH1 attenuator to 1V/cm and apply to both the CH1 input and to the Z mod jack at the rear of the oscilloscope a 10V 1kHz square wave. Check that blanking is operating at normal Intensity levels.

5-5. PACKING INFORMATION

The 1010A is a rugged instrument built to perform in severe environments. If the unit is to be shipped or stored for long periods of time the following packing procedure is recommended:

- a) Place the 1010A into an oversize plastic bag and seal the bag.
- b) Place the bagged 1010A into a heavy duty corrugated cardboard box. The box must contain at least 2 inches of rubberized hair or equivalent cushion on all six sides of the instrument. The counter must fit snugly into the cushion and the cushion must fit into the box to prevent any movement of the instrument in transit.
- c) Place the instruction manual into the box. If accessories are also to be packed put them into a separate plastic bag and pack into the cushion leaving at least two inches of cushion between the instrument and the accessories as well as an extra cushion between accessories and the box.
- d) Seal the box fully with 2 or 3 inch wide packing tape.
- e) Properly label and address outside of box with a typed label or an indelible pen.

If shipment is to the factory, notify Ballantine in advance and include detailed reasons for return inside box along with your name, firm and full mailing address. Also include your phone number and purchase order number.

Ship prepaid by United Parcel Service or Registered Air Parcel Post to:

**Ballantine Laboratories
90 Fanny Road
Post Office Box 97
Boonton, NJ USA 07005**

Section 6

Parts List and Circuit Diagrams

This section contains the schematics and parts lists for the 1010 Series Oscilloscope. The replacement parts listed are available from the vendors listed or from Ballantine Labs. Your local Ballantine Field Engineering Representative may also carry a stock of parts and can assist you. If pricing quotations are required for parts and or repairs your local representative will give the most rapid service or you may contact the Ballantine Factory directly.

When ordering replacement parts always give the following information:

- a) Instrument Model number
- b) Serial number
- c) Ballantine Part number
- d) Schematic Symbol number
- e) Identification of the part

Ballantine will do its best to improve the instrument and make changes in style of components and replacement parts. Replacement parts may differ in appearance from those found in your instrument but are always equal or superior in performance. Where necessary minor mechanical modifications may be required in the replacement of components.

Parts are generally available locally for most replacements. The parts list calls out the recommended vendors where applicable.

The Manufacturer Code is taken from Federal Supply Code Cataloging Handbooks H4-1, H4-2, and H4-3. Ballantine Code is 50423.

The following parts coding are used:

CVC	Capacitor, Variable, Ceramic
CCT	Capacitor, Ceramic, Tubular
CFP	Capacitor, Fixed, Plastic
CCD	Capacitor, Ceramic, Disc
CYF	Capacitor, Mylar, Foil
CMD	Capacitor, Mica, Dipped
CMM	Capacitor, Mica, Molded
CEA	Capacitor, Electrolytic, Aluminum
CET	Capacitor, Electrolytic, Tantalum
DGP	Diode, General Purpose
DZG	Diode, Zener, General Purpose
DRP	Diode, Bridge, Power
FLT	Filter
ICP	Integrated Circuit
TRQ	Transistor
RFF	Resistor, Fixed, Film
RFC	Resistor, Fixed, Composition
RVC	Resistor, Variable, Composition
RFW	Resistor, Fixed, Wirewound
SWG	Switch
LMB	Lamp
TRX	Transformer

Resistors may generally be replaced by Corning Electronics (CCW) type N-55, N-60 and C-32. Allen Bradley composition resistors type EB are also used.

Fixed Film Resistors may be replaced by ¼ watt type N-55 or ½ watt N-60. The latter has a larger body and is specified as the replacement part because of ready availability. When an N-60 is used as a replacement part, neatly bend its leads to fit the hole spacing provided for the shorter bodied ¼ watt N-55 resistor style.

INTERCONNECT

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION
C 10	07300010A	CVC 5.5/25PF350.
C 11	07022560A	CMM 68 PF 500 V
C 12	07250060A	CYM 0.01UF160.0
C 13	07100960A	CBM 1.0UF 200.0
C 14	07023710A	CMM 47 NF 200 V
C 15	07100590A	CYF 4.7UF 100.0V
C 16	07095790A	CCD 1 NF 150 VK 10%
C 21	07250000A	CYM 0.1 UF400.0
C 22	07025550A	CCD 20. NF 500 V
C 23	07250000A	CYM 0.1 UF400.0
C 24	07025550A	CCD 20. NF 500 V
C 25	07101540A	CCD 8.2PF 500.0
C 26	07250120A	CSM 470.0 PF500.0
C 27	07101540A	CCD 8.2PF 500.0
C 28	07250120A	CSM 470.0 PF500.0
C 31	07101720A	CEA 200.0UF 250.0
C 33	07101710A	CEA2200.0UF 40.0
C 34	07101710A	CEA2200.0UF 40.0
FS 30	19100080A	FUS .4 A/SB SIZE
MR 31	05100060A	DGP BRIDGE RECT.
MR 32	05100060A	DGP BRIDGE RECT.
N 31	16100010A	LMP 12V @100MA
R 10	C9100810A	RVC 100.0K 0.5W/SW
R 11	C9100820A	RVC 10.0K 0.5W/SW
R 12	C9100830A	RVC 2.2K 0.5W
R 13	12125000A	RFF 100.0 K 500 M
R 14	12150000A	RCF 82.00K 1.00
R 15	12125460A	RFF 301.0 K 500 M
R 16	12125670A	RFF 499.0 K 500 M
R 17	12126000A	RFF 1.00M 500 M
R 18	12150040A	RFF 3.01M 1.00
R 20	12026420A	RCF 990.0K 500 MW
R 21	12121320A	RFF 21.5 500 M
R 22	12121320A	RFF 21.5 500 M
R 23	12026420A	RCF 990.0K 500 MW
R 24	12125640A	RFF 464.0 K 500 M
R 25	12126000A	RFF 1.00M 500 M
R 26	12121320A	RFF 21.5 500 M
R 27	12121320A	RFF 21.5 500 M
R 28	12125640A	RFF 464.0 K 500 M
R 29	12126000A	RFF 1.00M 500 M
R 31	12124800A	RFF 68.1 K 500 M
R 33	C9100840A	RVC 220.0 K 0.5W/S
R 34	C9100850A	RVC 1.0 M 0.5W
R 40	12124200A	RFF 16.2 K 500 M
R 41	12124160A	RFF 14.7 K 500 M
R 42	12123680A	RFF 5.11K 500 M
R 43	12123230A	RFF 1.74K 500 M
R 44	12122840A	RFF 750.0 500 M
R 45	12122520A	RFF 348.0 500 M
R 46	12124200A	RFF 16.2 K 500 M
R 47	12124160A	RFF 14.7 K 500 M
R 48	12123680A	RFF 5.11K 500 M
R 49	12123230A	RFF 1.74K 500 M
R 50	12122840A	RFF 750.0 500 M
R 51	12122520A	RFF 348.0 500 M
R 52	C9100860A	RVC 22.0 K 0.5W/S
R 53	C9100860A	RVC 22.0 K 0.5W/S
R 54	12121320A	RFF 21.5 500 M
R 55	12121320A	RFF 21.5 500 M
SKA	31033790A	CON UG-1094/U, DAGE
SKB	31033790A	CON UG-1094/U, DAGE
SKD	48100010A	SOC TEFLON FDTHRU
SKE	48100010A	SOC TEFLON FDTHRU
SKF,G,H	48100020A	SOC 4MM BLK BANANA
TR 31	10100090A	TRQ TRANSISTOR TYP
TR 32	10100040A	TRQ NPN 30V 25W SI
V 1	21100070A	TBE CRT 4KV 8X10CM

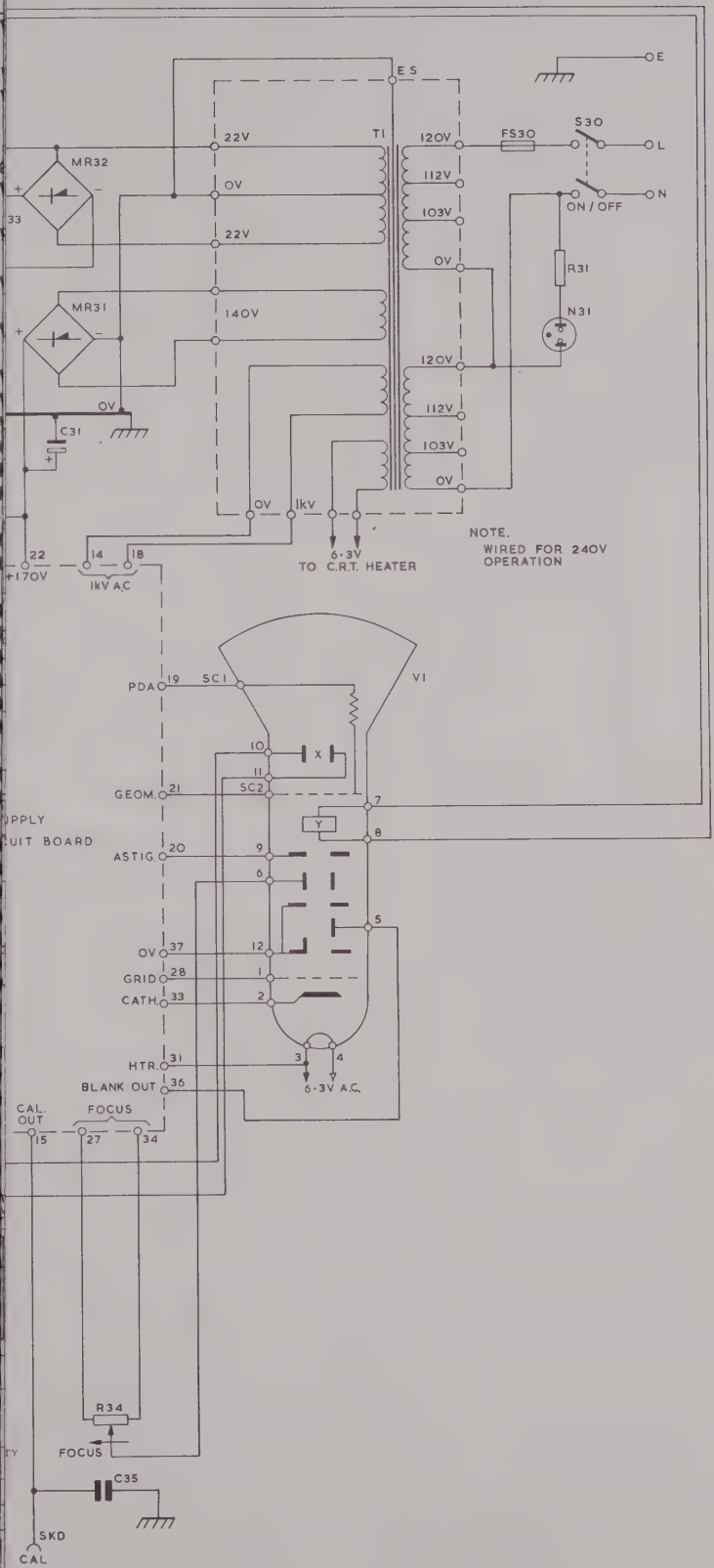


FIGURE 6-1. INTERCONNECTION DIAGRAM

Section 6

Parts List and Circuit Diagrams

This section contains the schematics and parts lists for the 1010 Series Oscilloscope. The replacement parts listed are available from the vendors listed or from Ballantine Labs. Your local Ballantine Field Engineering Representative may also carry a stock of parts and can assist you. If pricing quotations are required for parts and or repairs your local representative will give the most rapid service or you may contact the Ballantine Factory directly.

When ordering replacement parts always give the following information:

- a) Instrument Model number
- b) Serial number
- c) Ballantine Part number
- d) Schematic Symbol number
- e) Identification of the part

Ballantine will do its best to improve the instrument and make changes in style of components and replacement parts. Replacement parts may differ in appearance from those found in your instrument but are always equal or superior in performance. Where necessary minor mechanical modifications may be required in the replacement of components.

Parts are generally available locally for most replacements. The parts list calls out the recommended vendors where applicable.

The Manufacturer Code is taken from Federal Supply Code Cataloging Handbooks H4-1, H4-2, and H4-3. Ballantine Code is 50423.

The following parts coding are used:

CVC	Capacitor, Variable, Ceramic
CCT	Capacitor, Ceramic, Tubular
CFP	Capacitor, Fixed, Plastic
CCD	Capacitor, Ceramic, Disc
CYF	Capacitor, Mylar, Foil
CMD	Capacitor, Mica, Dipped
CMM	Capacitor, Mica, Molded
CEA	Capacitor, Electrolytic, Aluminum
CET	Capacitor, Electrolytic, Tantalum
DGP	Diode, General Purpose
DZG	Diode, Zener, General Purpose
DRP	Diode, Bridge, Power
FLT	Filter
ICP	Integrated Circuit
TRQ	Transistor
RFF	Resistor, Fixed, Film
RFC	Resistor, Fixed, Composition
RVC	Resistor, Variable, Composition
RFW	Resistor, Fixed, Wirewound
SWG	Switch
LMB	Lamp
TRX	Transformer

Resistors may generally be replaced by Corning Electronics (CCW) type N-55, N-60 and C-32. Allen Bradley composition resistors type EB are also used.

Fixed Film Resistors may be replaced by ¼ watt type N-55 or ½ watt N-60. The latter has a larger body and is specified as the replacement part because of ready availability. When an N-60 is used as a replacement part, neatly bend its leads to fit the hole spacing provided for the shorter bodied ¼ watt N-55 resistor style.

INTERCONNECTION DIAGRAM

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 10	C7300C1CA	CVC 5.5/25PF350. V	72982	TYP 538-014.D.5.5-25
C 11	C702256CA	CMM 6E PF 500 V T	84171	ARCC DM-15-680
C 12	C7250C60A	CYM 0.010UF160.0 VF +-1%	84171	ARCC DM30-103F
C 13	C7100C60A	CBM 1.0UF 200.0 VF	14752	ELECTROCUBE 625DIC105F
C 14	C702371CA	CMM 47 NF 200 V K 10%	56289	SPRAGUE TYPE 192P
C 15	C7100C55CA	CYF 4.7UF 100.0V M	34553	AMPEREX C280MAH/ANW7
C 16	07095790A	CCD 1NF 150VK 10%	71590	CTL TYP CE-102
C 21	C72500C0CA	CYM 0.1 UF400.0 VK +-20%	56289	418P10404LA3 RADIAL LEAD
C 22	C7025550A	CCD 20. NF 500 V M+-20%	72982	ERIE Y5V STYLE 841 GP 6
C 23	C725000CA	CYM 0.1 UF400.0 VK +-20%	56289	418P10404LA3 RADIAL LEAD
C 24	C7025550A	CCD 20. NF 500 V M+-20%	72982	ERIE Y5V STYLE 841 GP 6
C 25	C7101540A	CCD 8.2PF 500.0 V NPO+-1PF	72982	ERIE 831 NPO 8.2PF 1P500
C 26	C7250120A	CSM 470.0 PF500.0 K +-5 %	50423	SEE 07-02292-0A
C 27	C7101540A	CCD 8.2PF 500.0 V NPO+-1PF	72982	ERIE 831 NPO 8.2PF 1P500
C 28	C7250120A	CSM 470.0 PF500.0 K +-5 %	50423	SEE 07-02292-0A
C 31	C7101720A	CEA 200.0UF 250.0 V CAN/CLMP	90201	MLRY CGS101T2508B1/14F41
C 33	07101710A	CEA220C.0UF 40.0 V CAN/CLMP	90201	MLAY CGS222U0408B1/14F41
C 34	C7101710A	CEA220C.0UF 40.0 V CAN/CLMP	90201	MLAY CGS222U0408B1/14F41
FS 30	15100080A	FUS .4 A/SB SIZE 0 5X20MM	75915	LITTELFUSE 213.400
MR 31	05100060A	DGP BRIDGE RECT. MDA920-6A	04713	MOTOROLA
MR 32	05100060A	DGP BRIDGE RECT. MDA920-6A	04713	MOTOROLA
N 31	16100010A	LMP 12V 2100MA	80795	ITT SGF 1361-D-RD-12
F 10	C9100810A	RVC 100.0K 0.5W/SWC S10 R10	50423	
F 11	C9100820A	RVC 10.0K 0.5W/SWC S11 R11	50423	
F 12	C9100830A	RVC 2.2K 0.5W	50423	
F 13	12125000A	RFF 100.0 K 500 MW F+-1%	16299	CGW NA 60
F 14	1215000CA	RCF 82.0CK 1.00WJ +-5%	01121	ALLEN BRADLEY ABGB
F 15	12125460A	RFF 301.0 K 500 MW F+-1%	16299	CGW NA 60
F 16	12125670A	RFF 455.0 K 500 MW F+-1%	16299	CGW NA 60
F 17	1212600CA	RFF 1.00M 500 MW F+-1%	16299	CGW TYP NA 65
F 18	12150040A	RFF 3.01M 1.00WF +-1%	35929	CONSTANTA CO LTD N3
F 20	12026420A	RCF 990.0K 500 MW F+-1%	03888	PYF TYP TP-500
F 21	12121320A	RFF 21.5 500 MW F+-1%	16299	CGW NA 60
F 22	12121320A	RFF 21.5 500 MW F+-1%	16299	CGW NA 60
F 23	12026420A	RCF 990.0K 500 MW F+-1%	03888	PYF TYP TP-500
F 24	1212564CA	RFF 464.0 K 500 MW F+-1%	16299	CGW NA 60
F 25	1212600CA	RFF 1.00M 500 MW F+-1%	16299	CGW TYP NA 65
F 26	12121320A	RFF 21.5 500 MW F+-1%	16299	CGW NA 60
F 27	12121320A	RFF 21.5 500 MW F+-1%	16299	CGW NA 60
F 28	12125640A	RFF 464.0 K 500 MW F+-1%	16299	CGW NA 60
F 29	1212600CA	RFF 1.00M 500 MW F+-1%	16299	CGW TYP NA 65
F 31	1212480CA	RFF 68.1 K 500 MW F+-1%	16299	CGW NA 60
F 33	C9100840A	RVC 220.0 K 0.5W/SWC S30 R33	50423	
F 34	C910085CA	RVC 1.0 M 0.5W	50423	
F 40	1212420CA	RFF 16.2 K 500 MW F+-1%	16299	CGW NA 60
F 41	1212416CA	RFF 14.7 K 500 MW F+-1%	16299	CGW NA 60
F 42	1212368CA	RFF 5.11K 500 MW F+-1%	16299	CGW NA 60
F 43	12123230A	RFF 1.74K 500 MW F+-1%	16299	CGW NA 60
F 44	1212264CA	RFF 750.0 500 MW F+-1%	16299	CGW NA 60
F 45	12122520A	RFF 348.0 500 MW F+-1%	16299	CGW NA 60
F 46	1212420CA	RFF 16.2 K 500 MW F+-1%	16299	CGW NA 60
F 47	1212416CA	RFF 14.7 K 500 MW F+-1%	16299	CGW NA 60
F 48	1212368CA	RFF 5.11K 500 MW F+-1%	16299	CGW NA 60
F 49	12123230A	RFF 1.74K 500 MW F+-1%	16299	CGW NA 60
F 50	1212264CA	RFF 750.0 500 MW F+-1%	16299	CGW NA 60
F 51	12122520A	RFF 348.0 500 MW F+-1%	16299	CGW NA 60
F 52	C910086CA	RVC 22.0 K 0.5W/SWC S27 R52	50423	
F 53	C910086CA	RVC 22.0 K 0.5W/SWC S27 R52	50423	
F 54	12121320A	RFF 21.5 500 MW F+-1%	16299	CGW NA 60
F 55	12121320A	RFF 21.5 500 MW F+-1%	16299	CGW NA 60
SKA	31033790A	CON UG-1094/U,DAGE	29587	STATE ELECT.PARTS
SKB	31033790A	CON UG-1094/U,DAGE	29587	STATE ELECT.PARTS
SKC	48100010A	SOC TEFLON F0THRU TEST PT.	98291	011-2049/GOLD PLATE
SKD	48100010A	SOC TEFLON F0THRU TEST PT.	98291	011-2049/GOLD PLATE
SKF,G,H	48100020A	SOC 4MM BLK BANANA JACK	83330	1498
TR 31	10100090A	TRQ TRANSISTOR TYPE MPS6519	04713	MOTOROLA
TR 32	10100040A	TRQ NPN 30V 25W SI MJE520	04713	MOTOROLA
V 1	21100070A	TBE CRT 4KV 8X10CM P3 1010A	50423	

NOTE: C31, C33, & C34 replacements may be 1 inch or 1-3/8 inch inch diameter cans. Proper clamps will be provided and must be installed with two mounting screws.

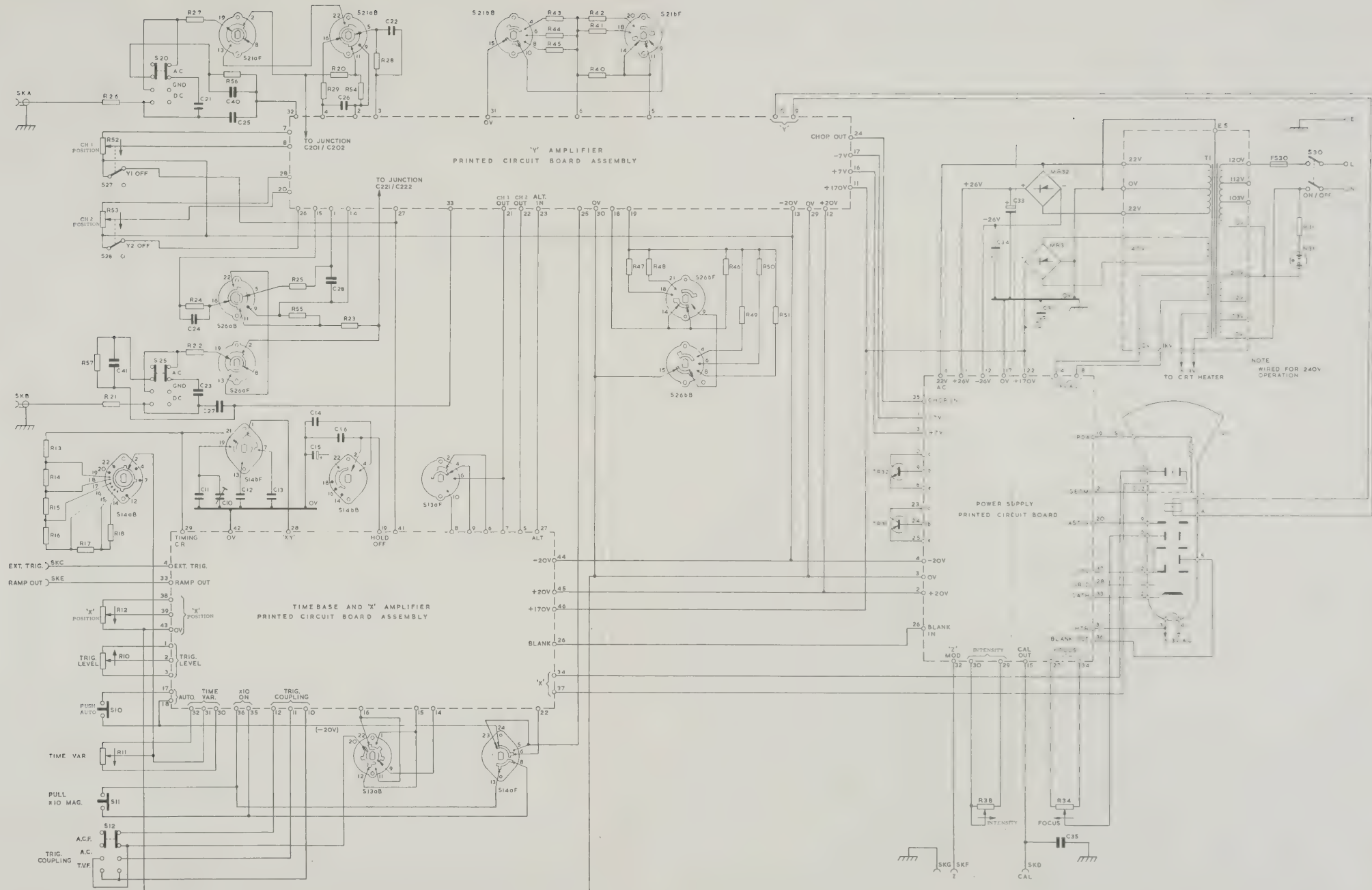


FIGURE 6-1. INTERCONNECTION DIAGRAM

'Y' AMPLIFIER (Continued)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R 208	1212264CA	RFF 464.0 500 MW F+-12	16299	CGW NA 60
R 209	12123800A	RFF 6.81K 500 MW F+-12	16299	CGW NA 60
R 210	1212332CA	RFF 2.15K 500 MW F+-12	16299	CGW NA 60
R 211	12123280A	RFF 1.96K 500 MW F+-12	16299	CGW NA 60
R 212	1212124CA	RFF 17.8 500 MW F+-12	16299	CGW NA 60
R 213	1212380CA	RFF 6.81K 500 MW F+-12	16299	CGW NA 60
R 214	1212232CA	RFF 215.0 500 MW F+-12	16299	CGW NA 60
R 215	12123520A	RFF 3.48K 500 MW F+-12	16299	CGW NA 60
R 216	1212352CA	RFF 3.48K 500 MW F+-12	16299	CGW NA 60
R 217	12122240A	RFF 178.0 500 MW F+-12	16299	CGW NA 60
R 218	1212524CA	RFF 178.0 K 500 MW F+-12	16299	CGW NA 60
R 219	1212408CA	RFF 12.1 K 500 MW F+-12	16299	CGW NA 60
R 220	1212100CA	RFF 10.0 500 MW F+-12	16299	CGW NA 60
R 221	12121640A	RFF 46.4 500 MW F+-12	16299	CGW NA 60
R 222	C9100040A	RVC 100. 0.5 WK +-10%	73138	HEL TYP 72PM
R 223	1212252CA	RFF 348.0 500 MW F+-12	16299	CGW NA 60
R 224	1212408CA	RFF 12.1 K 500 MW F+-12	16299	CGW NA 60
R 225	12121720A	RFF 56.2 500 MW F+-12	16299	CGW NA 60
R 226	1212352CA	RFF 3.48K 500 MW F+-12	16299	CGW NA 60
R 227	1212308CA	RFF 1.21K 500 MW F+-12	16299	CGW NA 60
R 228	1212280CA	RFF 681.0 500 MW F+-12	16299	CGW NA 60
R 229	1212100CA	RFF 10.0 500 MW F+-12	16299	CGW NA 60
R 230	12127610A	RFF 3.0 K 6.0 W 5% METOX	00327	WELWYN F76
R 231	1212164CA	RFF 46.4 500 MW F+-12	16299	CGW NA 60
R 232	12121640A	RFF 46.4 500 MW F+-12	16299	CGW NA 60
R 233	1212432CA	RFF 21.5 K 500 MW F+-12	16299	CGW NA 60
R 234	1212208CA	RFF 121.0 500 MW F+-12	16299	CGW NA 60
R 235	12127620A	RFF 820.0 4.0 W 5% METOX	16299	CORNING FP3
R 236	12124160A	RFF 14.7 K 500 MW F+-12	16299	CGW NA 60
R 237	1212224CA	RFF 178.0 500 MW F+-12	16299	CGW NA 60
R 238	12121640A	RFF 46.4 500 MW F+-12	16299	CGW NA 60
R 239	1212100CA	RFF 10.0 500 MW F+-12	16299	CGW NA 60
R 240	12127610A	RFF 3.0 K 6.0 W 5% METOX	00327	WELWYN F76
R 241	1212308CA	RFF 1.21K 500 MW F+-12	16299	CGW NA 60
R 242	1212340CA	RFF 2.61K 500 MW F+-12	16299	CGW NA 60
R 243	1212100CA	RFF 10.0 500 MW F+-12	16299	CGW NA 60
R 244	12122720A	RFF 562.0 500 MW F+-12	16299	CGW NA 60
R 245	1212332CA	RFF 2.15K 500 MW F+-12	16299	CGW NA 60
R 246	1212332CA	RFF 2.15K 500 MW F+-12	16299	CGW NA 60
R 247	1212332CA	RFF 2.15K 500 MW F+-12	16299	CGW NA 60
R 248	1212332CA	RFF 2.15K 500 MW F+-12	16299	CGW NA 60
R 249	1212164CA	RFF 46.4 500 MW F+-12	16299	CGW NA 60
R 250	1212100CA	RFF 10.0 500 MW F+-12	16299	CGW NA 60
R 251	121240CCA	RFF 10.0 K 500 MW F+-12	16299	CGW NA 60
R 252	C910087CA	RVC 22.0 K 0.5W R202 R52	50423	
R 253	1212424CA	RFF 17.8 K 500 MW F+-12	16299	CGW NA 60
R 254	1212264CA	RFF 464.0 500 MW F+-12	16299	CGW NA 60
R 255	12122640A	RFF 464.0 500 MW F+-12	16299	CGW NA 60
R 256	1212456CA	RFF 38.3 K 500 MW F+-12	16299	CGW NA 60
R 257	1212264CA	RFF 464.0 500 MW F+-12	16299	CGW NA 60
R 258	1212264CA	RFF 464.0 500 MW F+-12	16299	CGW NA 60
R 259	12123800A	RFF 6.81K 500 MW F+-12	16299	CGW NA 60
R 260	1212332CA	RFF 2.15K 500 MW F+-12	16299	CGW NA 60
R 261	12123280A	RFF 1.96K 500 MW F+-12	16299	CGW NA 60
R 262	1212124CA	RFF 17.8 500 MW F+-12	16299	CGW NA 60
R 263	1212380CA	RFF 6.81K 500 MW F+-12	16299	CGW NA 60
R 264	1212232CA	RFF 215.0 500 MW F+-12	16299	CGW NA 60
R 265	1212352CA	RFF 3.48K 500 MW F+-12	16299	CGW NA 60
R 266	1212352CA	RFF 3.48K 500 MW F+-12	16299	CGW NA 60
R 267	12122240A	RFF 178.0 500 MW F+-12	16299	CGW NA 60
R 268	1212524CA	RFF 178.0 K 500 MW F+-12	16299	CGW NA 60
R 269	1212408CA	RFF 12.1 K 500 MW F+-12	16299	CGW NA 60
R 270	121210CCA	RFF 10.0 500 MW F+-12	16299	CGW NA 60

'Y' AMPLIFIER

NOTES.

1. COMPONENTS CONTAINED WITHIN DOTTED LINES ARE NOT MOUNTED ON PRINTED CIRCUIT BOARD.

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION
R 271	121238CCA	RFF 6.81K 500
R 272	1212164CA	RFF 46.4 500
R 273	1212328CA	RFF 1.96K 500
R 274	1212332CA	RFF 2.15K 500
R 275	1212100CA	RFF 10.0 500
R 276	1212432CA	RFF 21.5 K 500
R 277	1212324CA	RFF 1.78K 500
R 278	121234CCA	RFF 2.61K 500
R 279	1212324CA	RFF 1.78K 500
R 280	1212416CA	RFF 14.7 K 500
R 281	1212432CA	RFF 21.5 K 500
R 282	1212432CA	RFF 21.5 K 500
R 283	1212416CA	RFF 14.7 K 500
R 284	1212432CA	RFF 21.5 K 500
R 285	121230CCA	RFF 1.0 K 500
R 286	1212356CA	RFF 3.63K 500
R 287	1212440CA	RFF 26.1 K 500
R 288	1212324CA	RFF 1.78K 500
R 289	1212364CA	RFF 4.64K 500
R 290	121238CCA	RFF 6.81K 500
R 291	121240CCA	RFF 10.0 K 500
R 292	1212440CA	RFF 26.1 K 500
TR 201	1010000CA	TRQ TRANSISTOR
TR 202	1010000CA	TRQ TRANSISTOR
TR 203	1009473CA	TRQ 2N3906
TR 204	1009465CA	TRQ
TR 205	1007934CA	TRQ 2N3640
TR 206	1007934CA	TRQ 2N3640
TR 207	1009465CA	TRQ
TR 208	1010001CA	TRQ TRANSISTOR TYP
TR 209	1010001CA	TRQ TRANSISTOR TYP
TR 210	1010056CA	TRQ NPN 180V
TR 211	1010056CA	TRQ NPN 180V
TR 212	1010000CA	TRQ TRANSISTOR
TR 213	1010000CA	TRQ TRANSISTOR
TR 214	1009465CA	TRQ
TR 215	0510012CA	DRS HI-V 12KV PIV
TR 216	0510012CA	DRS HI-V 12KV PIV
TR 217	1009465CA	TRQ
TR 218	1010001CA	TRQ TRANSISTOR TYP
TR 219	1010001CA	TRQ TRANSISTOR TYP
TR 220	1009473CA	TRQ 2N3906
TR 221	1009473CA	TRQ 2N3906
TR 222	1009473CA	TRQ 2N3906

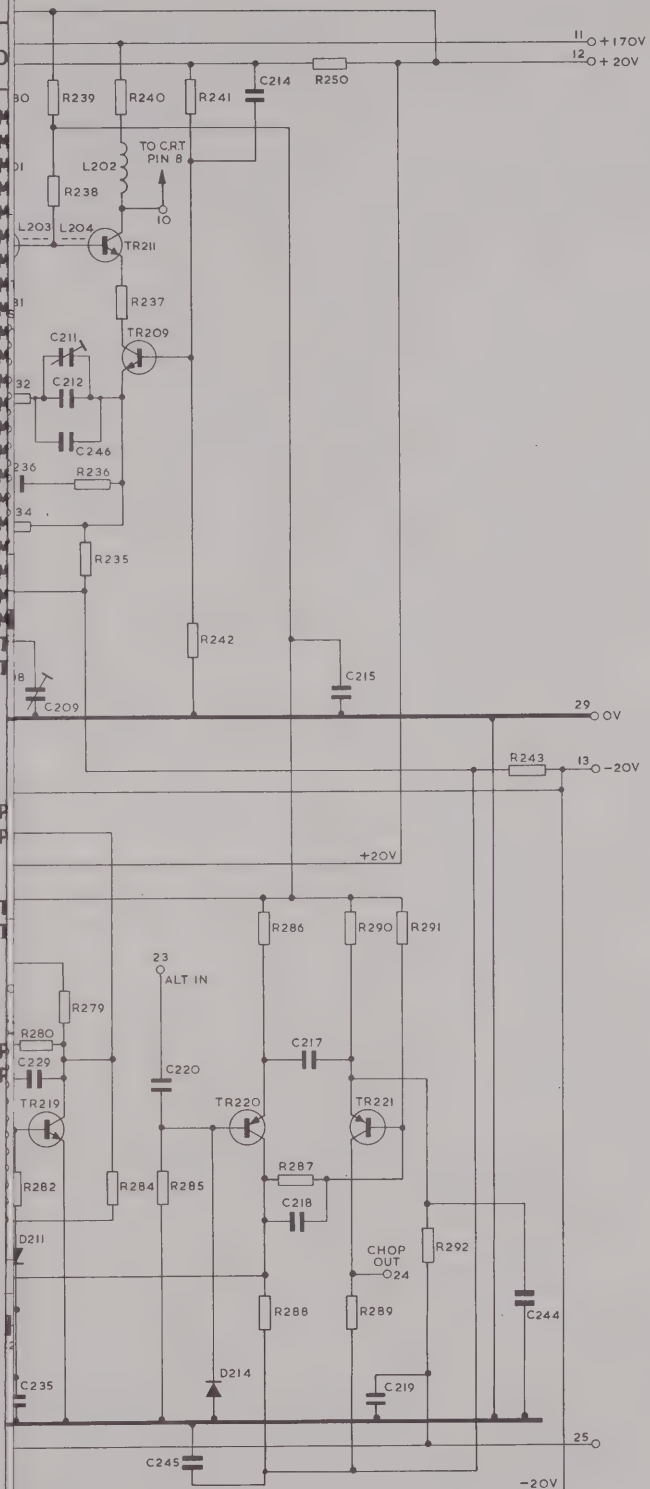


FIGURE 6-2. 'Y' AMPLIFIER

'Y' AMPLIFIER

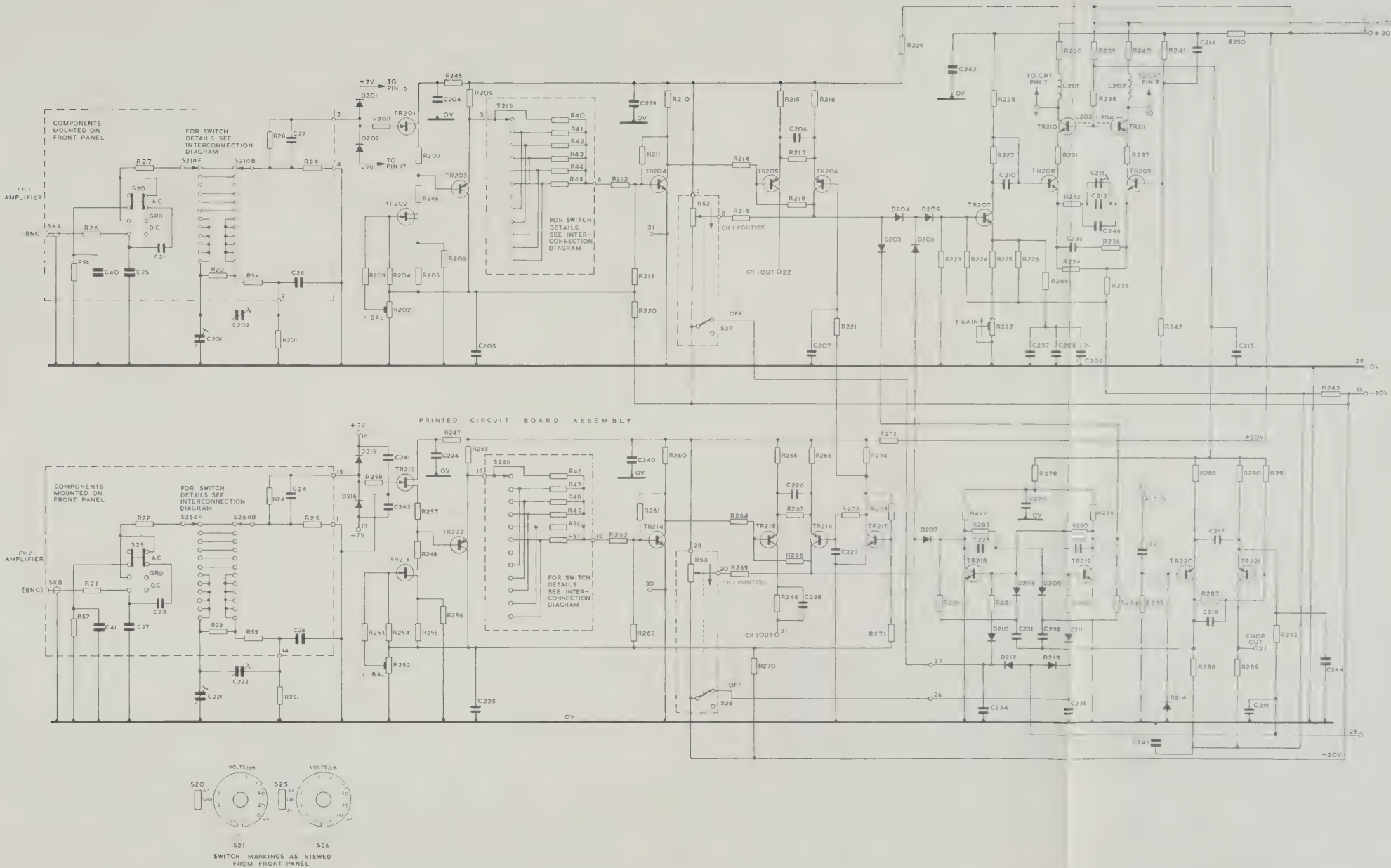
SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 201	07300000A	CVC .8/6.8PF400. V	73445	C0004EA/6E
C 202	07300000A	CVC .8/6.8PF400. V	73445	C0004EA/6E
C 204	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 205	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 206	07200020A	CCD 30.0PF 500.0 VK +-10%	71590	CTL DD-390
C 207	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 208	07200020A	CCD 30.0PF 500.0 VK +-10%	71590	CTL DD-390
C 209	07300020A	CVC 9/35PF250.0 V	73445	ERIE 538-0110-9-35
C 210	07095790A	CCD 1 NF 150 VK 10%	71590	CTL TYP CE-102
C 211	07300020A	CVC 9/35PF250.0 V	73445	ERIE 538-0110-9-35
C 212	07250090A	CSM 330.0 PF125. VK +-10%	50423	SEE 07-02290-0A
C 213	07101730A	CCD 270.0PF 500.0 V 10%	00656	AEROCVX GPD5F271K OR EQ
C 214	07200100A	CCD 68.0PF 250.0 VK+-10%	71590	CTL DD-680
C 215	07200050A	CCD 0.1UF 30.0 C VK +-10%	71590	CTL CK-104
C 217	07101740A	CCD 560.0PF 500.0 V 10%	00656	AEROCVX GPD5F561K OR EQ
C 218	07200100A	CCD 68.0PF 250.0 VK+-10%	71590	CTL DD-680
C 219	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 220	07200030A	CCD 47.0PF 500.0 VK +-10%	71590	CTL DD-470
C 221	07300000A	CVC .8/6.8PF400. V	73445	C0004EA/6E
C 222	07300000A	CVC .8/6.8PF400. V	73445	C0004EA/6E
C 224	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 225	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 226	07200030A	CCD 47.0PF 500.0 VK +-10%	71590	CTL DD-470
C 227	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 228	07200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 229	07200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 230	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 231	07200090A	CMD 15.0PF 500.0 VJ +- 5%	50423	SEE 07-02241-0A
C 232	07200090A	CMD 15.0PF 500.0 VJ +- 5%	50423	SEE 07-02241-0A
C 234	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 235	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 236	07200030A	CCD 47.0PF 500.0 VK +-10%	71590	CTL DD-470
C 237	07200020A	CCD 30.0PF 500.0 VK +-10%	71590	CTL DD-390
C 238	07095520A	CCD 100 PF 1 KV K 10%	84171	ARC TYP CCD-101
C 239	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 240	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 241	07200050A	CCD 0.1UF 30.0 VK +-10%	71590	CTL CK-104
C 242	07200050A	CCD 0.1UF 30.0 VK +-10%	71590	CTL CK-104
C 243	07200050A	CCD 0.1UF 30.0 VK +-10%	71590	CTL CK-104
C 244	07095730A	CCD 330 PF 500 V K 10%	71590	CTL TYP CE-331
C 245	07200050A	CCD 0.1UF 30.0 VK +-10%	71590	CTL CK-104
D 201	05100010A	DGP 1N3595	12954	DICKSON ELECTRONICS
D 202	05100010A	DGP 1N3595	12954	DICKSON ELECTRONICS
D 203	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 204	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 205	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 206	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 207	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 208	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 209	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 210	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 211	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 212	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 213	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 214	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 215	05100010A	DGP 1N3595	12954	DICKSON ELECTRONICS
D 216	05100010A	DGP 1N3595	12954	DICKSON ELECTRONICS
L 201	03100270A	CRF 33UH 50 MA Q50/2MHZ	76493	J.W.MILLER 70F335A1 OR E
L 202	03100270A	CRF 33UH 50 MA Q50/2MHZ	76493	J.W.MILLER 70F335A1 OR E
L 203	46100000A	FRB FERRITE BEAD	78488	STACKPOLE 57-0180-7D MAT
L 204	46100000A	FRB FERRITE BEAD	78488	STACKPOLE 57-0180-7D MAT
R 201	12124000A	RFF 10.0 K 500 MW F+-1%	16299	CGW NA 60
R 202	09100870A	RVC 22.0 K 0.5W R202 R52	50423	ADV. A4/32894 1010A
R 203	12124240A	RFF 17.8 K 500 MW F+-1%	16299	CGW NA 60
R 204	12122640A	RFF 464.0 500 MW F+-1%	16299	CGW NA 60
R 205	12122640A	RFF 464.0 500 MW F+-1%	16299	CGW NA 60
R 206	12124560A	RFF 38.3 K 500 MW F+-1%	16299	CGW NA 60
R 207	12122640A	RFF 464.0 500 MW F+-1%	16299	CGW NA 60

'Y' AMPLIFIER (Continued)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R 208	12122640A	RFF 464.0 500 MW F+-1%	16299	CGW NA 60
R 209	12123800A	RFF 6.81K 500 MW F+-1%	16299	CGW NA 60
R 210	12123320A	RFF 2.15K 500 MW F+-1%	16299	CGW NA 60
R 211	12123280A	RFF 1.96K 500 MW F+-1%	16299	CGW NA 60
R 212	12121240A	RFF 17.8 500 MW F+-1%	16299	CGW NA 60
R 213	12123800A	RFF 6.81K 500 MW F+-1%	16299	CGW NA 60
R 214	12122320A	RFF 215.0 500 MW F+-1%	16299	CGW NA 60
R 215	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
R 216	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
R 217	12122240A	RFF 178.0 500 MW F+-1%	16299	CGW NA 60
R 218	12125240A	RFF 178.0 K 500 MW F+-1%	16299	CGW NA 60
R 219	12124080A	RFF 12.1 K 500 MW F+-1%	16299	CGW NA 60
R 220	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 221	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
R 222	09100040A	RVC 100. 0.5 WK +-10%	73138	HEL TYP 72PM
R 223	12122520A	RFF 348.0 500 MW F+-1%	16299	CGW NA 60
R 224	12124080A	RFF 12.1 K 500 MW F+-1%	16299	CGW NA 60
R 225	12121720A	RFF 56.2 500 MW F+-1%	16299	CGW NA 60
R 226	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
R 227	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
R 228	12122800A	RFF 681.0 500 MW F+-1%	16299	CGW NA 60
R 229	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 230	12127610A	RFF 3.0 K 6.0 W 5% METOX	00327	WELWYN F76
R 231	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
R 232	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
R 233	12124320A	RFF 21.5 K 500 MW F+-1%	16299	CGW NA 60
R 234	12122080A	RFF 121.0 500 MW F+-1%	16299	CGW NA 60
R 235	12127620A	RFF 820.0 4.0 W 5% METOX	16299	CORNING FP3
R 236	12124160A	RFF 14.7 K 500 MW F+-1%	16299	CGW NA 60
R 237	12122240A	RFF 178.0 500 MW F+-1%	16299	CGW NA 60
R 238	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
R 239	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 240	12127610A	RFF 3.0 K 6.0 W 5% METOX	00327	WELWYN F76
R 241	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
R 242	12123400A	RFF 2.61K 500 MW F+-1%	16299	CGW NA 60
R 243	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 244	12122720A	RFF 562.0 500 MW F+-1%	16299	CGW NA 60
R 245	12123320A	RFF 2.15K 500 MW F+-1%	16299	CGW NA 60
R 246	12123320A	RFF 2.15K 500 MW F+-1%	16299	CGW NA 60
R 247	12123320A	RFF 2.15K 500 MW F+-1%	16299	CGW NA 60
R 248	12123320A	RFF 2.15K 500 MW F+-1%	16299	CGW NA 60
R 249	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
R 250	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 251	12124000A	RFF 10.0 K 500 MW F+-1%	16299	CGW NA 60
R 252	09100070A	RVC 22.0 K 0.5W R202 R52	50423	
R 253	12124240A	RFF 17.8 K 500 MW F+-1%	16299	CGW NA 60
R 254	12122640A	RFF 464.0 500 MW F+-1%	16299	CGW NA 60
R 255	12122640A	RFF 464.0 500 MW F+-1%	16299	CGW NA 60
R 256	12124560A	RFF 38.3 K 500 MW F+-1%	16299	CGW NA 60
R 257	12122640A	RFF 464.0 500 MW F+-1%	16299	CGW NA 60
R 258	12122640A	RFF 464.0 500 MW F+-1%	16299	CGW NA 60
R 259	12123800A	RFF 6.81K 500 MW F+-1%	16299	CGW NA 60
R 260	12123320A	RFF 2.15K 500 MW F+-1%	16299	CGW NA 60
R 261	12123280A	RFF 1.96K 500 MW F+-1%	16299	CGW NA 60
R 262	12121240A	RFF 17.8 500 MW F+-1%	16299	CGW NA 60
R 263	12123800A	RFF 6.81K 500 MW F+-1%	16299	CGW NA 60
R 264	12122320A	RFF 215.0 500 MW F+-1%	16299	CGW NA 60
R 265	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
R 266	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
R 267	12122240A	RFF 178.0 500 MW F+-1%	16299	CGW NA 60
R 268	12125240A	RFF 178.0 K 500 MW F+-1%	16299	CGW NA 60
R 269	12124080A	RFF 12.1 K 500 MW F+-1%	16299	CGW NA 60
R 270	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60

'Y' AMPLIFIER (Continued)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R 271	121238CCA	RFF 6.81K 50C MW F+-1%	16299	CGW NA 60
F 272	1212164CA	RFF 46.4 50C MW F+-1%	16299	CGW NA 60
R 273	1212228CA	RFF 1.96K 50C MW F+-1%	16299	CGW NA 60
R 274	1212332CA	RFF 2.15K 50C MW F+-1%	16299	CGW NA 60
F 275	121210CCA	RFF 10.0 50C MW F+-1%	16299	CGW NA 60
F 276	1212432CA	RFF 21.5 K 50C MW F+-1%	16299	CGW NA 60
F 277	1212324CA	RFF 1.78K 50C MW F+-1%	16299	CGW NA 60
F 278	1212340CA	RFF 2.61K 50C MW F+-1%	16299	CGW NA 60
F 279	1212324CA	RFF 1.78K 50C MW F+-1%	16299	CGW NA 60
R 280	1212416CA	RFF 14.7 K 50C MW F+-1%	16299	CGW NA 60
R 281	1212432CA	RFF 21.5 K 50C MW F+-1%	16299	CGW NA 60
F 282	1212432CA	RFF 21.5 K 50C MW F+-1%	16299	CGW NA 60
R 283	1212416CA	RFF 14.7 K 50C MW F+-1%	16299	CGW NA 60
F 284	1212432CA	RFF 21.5 K 50C MW F+-1%	16299	CGW NA 60
F 285	121230CCA	RFF 1.0 K 50C MW F+-1%	16299	CGW NA 60
F 286	1212356CA	RFF 3.83K 50C MW F+-1%	16299	CGW NA 60
F 287	1212440CA	RFF 26.1 K 50C MW F+-1%	16299	CGW NA 60
F 288	1212324CA	RFF 1.78K 50C MW F+-1%	16299	CGW NA 60
F 289	1212364CA	RFF 4.64K 50C MW F+-1%	16299	CGW NA 60
F 290	121238CCA	RFF 6.81K 50C MW F+-1%	16299	CGW NA 60
F 291	121240CCA	RFF 10.0 K 50C MW F+-1%	16299	CGW NA 60
F 292	1212440CA	RFF 26.1 K 50C MW F+-1%	16299	CGW NA 60
TR 201	1C1000CCA	TRQ TRANSISTOR TYPE UC734	21845	SEE 10079330A
TR 202	1C1000CCA	TRQ TRANSISTOR TYPE UC734	21845	SEE 10079330A
TR 203	1C05473CA	TRQ 2N3906	04713	MOTOROLA
TR 204	1C05465CA	TRQ 2N3904	04713	REF. TO 10-10043-0A
TR 205	1C07934CA	TRQ 2N3640	07263	FAIRCHILD
TR 206	1C07934CA	TRQ 2N3640	07263	FAIRCHILD
TR 207	1C09465CA	TRQ 2N3904	04713	REF. TO 10-10043-0A
TR 208	1C10001CA	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 209	1C10001CA	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 210	1C10056CA	TRQ NPN 180V MPS-U04	04713	MOTOROLA UNIWATT BF380
TR 211	1C10056CA	TRQ NPN 180V MPS-U04	04713	MOTOROLA UNIWATT BF380
TR 212	1C10000CA	TRQ TRANSISTOR TYPE UC734	21845	SEE 10079330A
TR 213	1C10000CA	TRQ TRANSISTOR TYPE UC734	21845	SEE 10079330A
TR 214	1C09465CA	TRQ 2N3904	04713	REF. TO 10-10043-0A
TR 215	0510012CA	DRS HI-V 12KV PIV	11961	HV2.5-12F
TR 216	0510012CA	DRS HI-V 12KV PIV	11961	HV2.5-12F
TR 217	1C05465CA	TRQ 2N3904	04713	REF. TO 10-10043-0A
TR 218	1C10001CA	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 219	1C10001CA	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 220	1C05473CA	TRQ 2N3906	04713	MOTOROLA
TR 221	1C05473CA	TRQ 2N3906	04713	MOTOROLA
TR 222	1C05473CA	TRQ 2N3906	04713	MOTOROLA



TIMEBASE & 'X' AMPLIFIER

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 101	C709552CA	CCD 100 PF 1 KV K 10%	84171	ARC TYP CCD-101
C 102	C7095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 103	C7078350A	CEA 25 UF 25 V T	73445	AMPEREX C426AR/F25
C 104	C7095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 105	C7095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 106	C7095580A	CCD 33.0PF 500.0VK +-10%	56289	SPG TYP C03081026330K
C 107	C7101640A	CCD 470.0NF 100.0 V GMV	72982	ERIE 8131-100 651 474M
C 108	C7095580A	CCD 33.0PF 500.0VK +-10%	56289	SPG TYP C03081026330K
C 109	C7200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 110	C7200050A	CCD 0.1UF 30.0 VK +-10%	71590	CTL CK-104
C 111	C7200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 112	C7078350A	CEA 25 UF 25 V T	73445	AMPEREX C426AR/F25
C 113	C7101640A	CCD 470.0NF 100.0 V GMV	72982	ERIE 8131-100 651 474M
C 117	C7200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 118	C7200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 119	C7200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 120	C7095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 121	C709552CA	CCD 100 PF 1 KV K 10%	84171	ARC TYP CCD-101
C 122	C7200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 128	C7101750A	CSF 180.0PF 500.0 V 5%	71590	CTL TYPE CPR-180J
C 129	C7095510A	CCD 10 PF 1 KV K 10%	84171	ARC TYP CCD-100
D 101	C5100010A	DGP 1N3595	12954	DICKSON ELECTRONICS
D 102	C5100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 103	C5100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 104	C5100030A	DZG 8.2V +-5% 400MW 1N959B	12954	DICKSON ELECTRONICS
D 105	C5100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 106	C5100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 107	C5100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 108	C5100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 109	C5100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 110	C5100020A	DGP 1N914	12954	DICKSON ELECTRONICS
R 101	12124320A	RFF 21.5 K 500 MW F+-1%	16299	CGW NA 60
R 102	12124320A	RFF 21.5 K 500 MW F+-1%	16299	CGW NA 60
R 103	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
R 104	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
R 105	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 106	12012510A	RFC 100.0K 1 W J+- 5%	01121	A-B TYP GB
R 107	12122720A	RFF 562.0 500 MW F+-1%	16299	CGW NA 60
R 108	12122320A	RFF 215.0 500 MW F+-1%	16299	CGW NA 60
R 109	12122320A	RFF 215.0 500 MW F+-1%	16299	CGW NA 60
F 110	12122760A	RFF 619.0 500 MW F+-1%	16299	CGW NA 60
F 111	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
F 112	12122560A	RFF 383.0 500 MW F+-1%	16299	CGW NA 60
F 113	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
F 114	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
F 115	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
F 116	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
F 117	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
F 118	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
F 119	12125000A	RFF 100.0 K 500 MW F+-1%	16299	CGW NA 60
F 120	12123800A	RFF 6.81K 500 MW F+-1%	16299	CGW NA 60
F 121	12122400A	RFF 261.0 500 MW F+-1%	16299	CGW NA 60
F 122	12123160A	RFF 1.47K 500 MW F+-1%	16299	CGW NA 60
F 123	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
F 124	12126000A	RFF 1.00M 500 MW F+-1%	16299	CGW TYP NA 65
F 125	12122000A	RFF 100.0 500 MW F+-1%	16299	CGW NA 60
F 126	12123640A	RFF 4.64K 500 MW F+-1%	16299	CGW NA 60
F 127	12124000A	RFF 10.0 K 500 MW F+-1%	16299	CGW NA 60
F 128	12123320A	RFF 2.15K 500 MW F+-1%	16299	CGW NA 60
F 129	12122080A	RFF 121.0 500 MW F+-1%	16299	CGW NA 60
F 130	12123000A	RFF 1.0 K 500 MW F+-1%	16299	CGW NA 60
F 131	12123000A	RFF 1.0 K 500 MW F+-1%	16299	CGW NA 60
F 132	12123400A	RFF 2.61K 500 MW F+-1%	16299	CGW NA 60
F 133	12123000A	RFF 1.0 K 500 MW F+-1%	16299	CGW NA 60
F 134	12124080A	RFF 12.1 K 500 MW F+-1%	16299	CGW NA 60
F 135	12124240A	RFF 17.8 K 500 MW F+-1%	16299	CGW NA 60
F 136	12123560A	RFF 3.83K 500 MW F+-1%	16299	CGW NA 60
F 137	12123560A	RFF 3.83K 500 MW F+-1%	16299	CGW NA 60

TIMEBASE & 'X'

SCHEMATIC REF		BALLANTINE PART NO.	DESCRIPTION
R	138	12124000A	RFF 10.0 K 500
R	139	12124640A	RFF 46.4 K 500
R	140	12124640A	RFF 46.4 K 500
R	141	12125000A	RFF 100.0 K 500
R	142	12124000A	RFF 10.0 K 500
R	143	12123000A	RFF 1.0 K 500
R	144	12123160A	RFF 1.47K 500
R	145	12125000A	RFF 100.0 K 500
R	146	12124160A	RFF 14.7 K 500
R	147	12127630A	RFC 2.2 M 600.0
R	148	12124800A	RFF 68.1 K 500
F	149	12123400A	RFF 2.61K 500
R	150	12122000A	RFF 100.0 500
F	151	12123080A	RFF 1.21K 500
R	152	12127640A	RFF 56.2 K 1.0
R	153	12124400A	RFF 26.1 K 500
R	154	12123560A	RFF 3.83K 500
R	155	12124240A	RFF 17.8 K 500
F	156	12122000A	RFF 100.0 500
R	157	12127640A	RFF 56.2 K 1.0
R	158	12122400A	RFF 261.0 500
F	159	12123400A	RFF 2.61K 500
R	160	12127650A	RFF 10.0 K 4.0
R	161	12122000A	RFF 100.0 500
F	162	09100040A	RVC 100. 0.5
R	163	12123280A	RFF 1.96K 500
R	164	12123240A	RFF 1.78K 500
R	166	12123160A	RFF 1.47K 500
F	167	12122000A	RFF 100.0 500
F	168	12127650A	RFF 10.0 K 4.0
R	169	09100060A	RVC 1.0 K 0.5
F	170	12123280A	RFF 1.96K 500
F	171	12127640A	RFF 56.2 K 1.0
R	172	12123240A	RFF 1.78K 500
F	173	12122000A	RFF 100.0 500
R	174	12123240A	RFF 1.78K 500
R	175	12123240A	RFF 1.78K 500
F	176	12121000A	RFF 10.0 500
F	177	12124000A	RFF 10.0 K 500
F	178	12121400A	RFF 26.1 500
R	179	12125400A	RFF 261.0 K 500
TR	101	10100010A	TRQ TRANSISTOR TY
TR	102	10100010A	TRQ TRANSISTOR TY
TR	103	10100010A	TRQ TRANSISTOR TY
TR	104	10100010A	TRQ TRANSISTOR TY
TR	105	10094730A	TRQ 2N3906
TR	106	10100020A	TRQ TRANSISTOR TY
TR	107	10100020A	TRQ TRANSISTOR TY
TR	108	10100010A	TRQ TRANSISTOR TY
TR	109	10100010A	TRQ TRANSISTOR TY
TR	110	10100010A	TRQ TRANSISTOR TY
TR	111	10094730A	TRQ 2N3906
TR	112	10094730A	TRQ 2N3906
TR	113	10100020A	TRQ TRANSISTOR TY
TR	114	10094730A	TRQ 2N3906
TR	115	10100160A	TRQ TRANSISTOR TY
TR	116	10100160A	TRQ TRANSISTOR TY
TR	117	10094730A	TRQ 2N3906

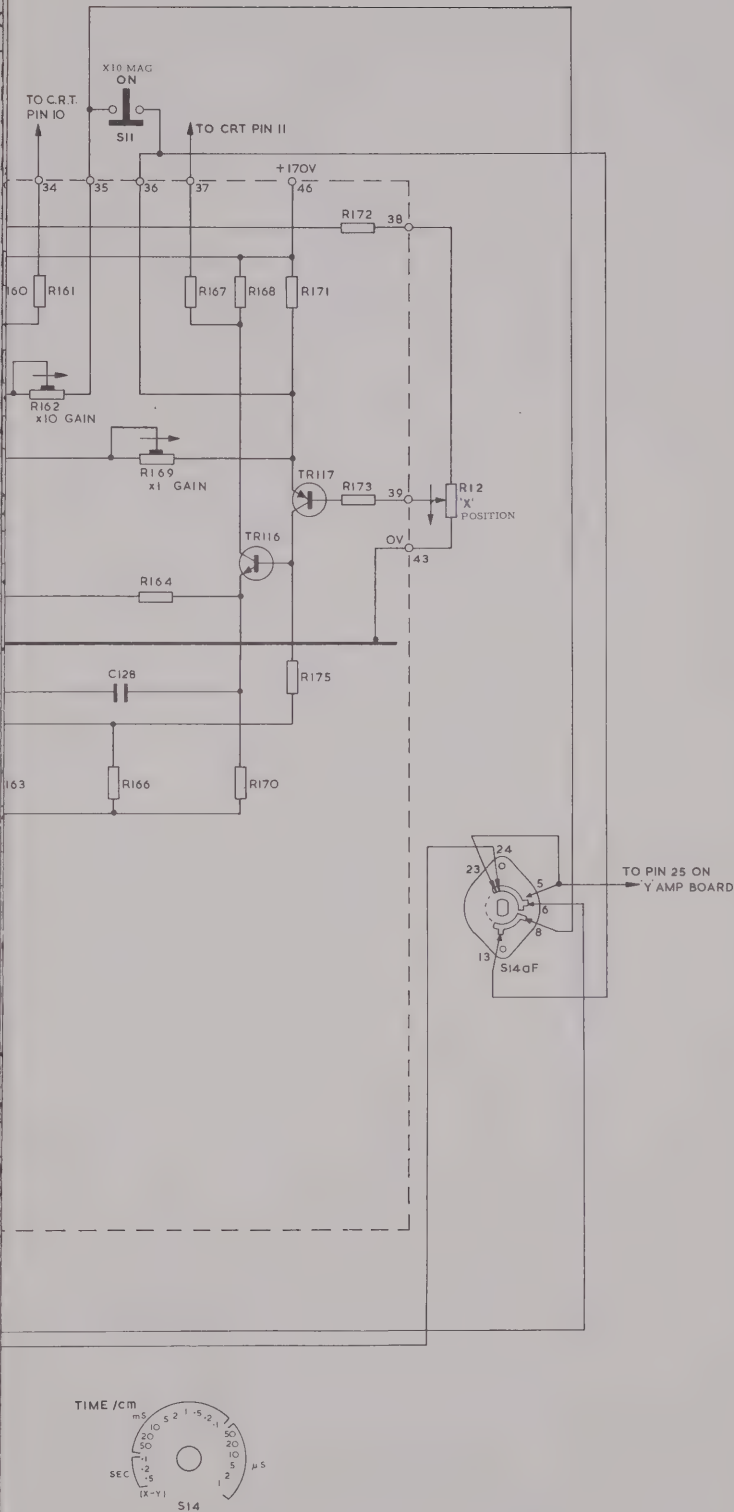


FIGURE 6-3. TIMEBASE & 'X' AMPLIFIER

TIMEBASE & 'X' AMPLIFIER

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 101	07095520A	CCD 100 PF 1 KV K 10%	84171	ARC TYP CCD-101
C 102	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 103	07078350A	CEA 25 UF 25 V T	73445	AMPEREX C426AR/F25
C 104	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 105	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 106	07095580A	CCD 33.0PF 500.0VK +-10%	56289	SPG TYP C030B1026330K
C 107	07101640A	CCD 470.0NF 100.0 V GMV	72982	ERIE 8131-100 651 474M
C 108	07095580A	CCD 33.0PF 500.0VK +-10%	56289	SPG TYP C030B1026330K
C 109	07200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 110	07200050A	CCD 0.1UF 30.0 VK +-10%	71590	CTL CK-104
C 111	07200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 112	07078350A	CEA 25 UF 25 V T	73445	AMPEREX C426AR/F25
C 113	07101640A	CCD 470.0NF 100.0 V GMV	72982	ERIE 8131-100 651 474M
C 117	07200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 118	07200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 119	07200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 120	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 121	07095520A	CCD 100 PF 1 KV K 10%	84171	ARC TYP CCD-101
C 122	07200040A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C 128	07101750A	CSF 180.0PF 500.0 V 5%	71590	CTL TYPE CPR-180J
C 129	07095510A	CCD 10 PF 1 KV K 10%	84171	ARC TYP CCD-100
D 101	05100010A	DGP 1N3595	12954	DICKSON ELECTRONICS
D 102	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 103	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 104	05100030A	DZG 8.2V +-5% 400MW 1N959B	12954	DICKSON ELECTRONICS
D 105	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 106	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 107	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 108	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 109	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 110	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
R 101	12124320A	RFF 21.5 K 500 MW F+-1%	16299	CGW NA 60
R 102	12124320A	RFF 21.5 K 500 MW F+-1%	16299	CGW NA 60
R 103	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
R 104	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
R 105	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 106	1201251CA	RFC 100.0K 1 W J+- 5%	01121	A-B TYP GB
R 107	12122720A	RFF 562.0 500 MW F+-1%	16299	CGW NA 60
R 108	12122320A	RFF 215.0 500 MW F+-1%	16299	CGW NA 60
R 109	12122320A	RFF 215.0 500 MW F+-1%	16299	CGW NA 60
R 110	12122760A	RFF 619.0 500 MW F+-1%	16299	CGW NA 60
R 111	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 112	12122560A	RFF 383.0 500 MW F+-1%	16299	CGW NA 60
R 113	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
R 114	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
R 115	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
R 116	12123080A	RFF 1.21K 500 MW F+-1%	16299	CGW NA 60
R 117	12121000A	RFF 10.0 500 MW F+-1%	16299	CGW NA 60
R 118	12121640A	RFF 46.4 500 MW F+-1%	16299	CGW NA 60
R 119	12125000A	RFF 100.0 K 500 MW F+-1%	16299	CGW NA 60
R 120	12123800A	RFF 6.81K 500 MW F+-1%	16299	CGW NA 60
R 121	12122400A	RFF 261.0 500 MW F+-1%	16299	CGW NA 60
R 122	12123160A	RFF 1.47K 500 MW F+-1%	16299	CGW NA 60
R 123	12123520A	RFF 3.48K 500 MW F+-1%	16299	CGW NA 60
R 124	12126000A	RFF 1.00M 500 MW F+-1%	16299	CGW TYP NA 65
R 125	12122000A	RFF 100.0 500 MW F+-1%	16299	CGW NA 60
R 126	12123640A	RFF 4.64K 500 MW F+-1%	16299	CGW NA 60
R 127	12124000A	RFF 10.0 K 500 MW F+-1%	16299	CGW NA 60
R 128	12123320A	RFF 2.15K 500 MW F+-1%	16299	CGW NA 60
R 129	12122080A	RFF 121.0 500 MW F+-1%	16299	CGW NA 60
R 130	12123000A	RFF 1.0 K 500 MW F+-1%	16299	CGW NA 60
R 131	12123000A	RFF 1.0 K 500 MW F+-1%	16299	CGW NA 60
R 132	12123400A	RFF 2.61K 500 MW F+-1%	16299	CGW NA 60
R 133	12123000A	RFF 1.0 K 500 MW F+-1%	16299	CGW NA 60
R 134	12124080A	RFF 12.1 K 500 MW F+-1%	16299	CGW NA 60
R 135	12124240A	RFF 17.8 K 500 MW F+-1%	16299	CGW NA 60
R 136	12123560A	RFF 3.83K 500 MW F+-1%	16299	CGW NA 60
R 137	12123560A	RFF 3.83K 500 MW F+-1%	16299	CGW NA 60

TIMEBASE & 'X' AMPLIFIER (Continued)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R 138	12124000A	RFF 10.0 K 500 MW F+1%	16299	CGW NA 60
R 139	12124640A	RFF 46.4 K 500 MW F+1%	16299	CGW NA 60
R 140	12124640A	RFF 46.4 K 500 MW F+1%	16299	CGW NA 60
R 141	12125000A	RFF 100.0 K 500 MW F+1%	16299	CGW NA 60
R 142	12124000A	RFF 10.0 K 500 MW F+1%	16299	CGW NA 60
R 143	12123000A	RFF 1.0 K 500 MW F+1%	16299	CGW NA 60
R 144	12123160A	RFF 1.47K 500 MW F+1%	16299	CGW NA 60
R 145	12125000A	RFF 100.0 K 500 MW F+1%	16299	CGW NA 60
R 146	12124160A	RFF 14.7 K 500 MW F+1%	16299	CGW NA 60
R 147	12127630A	RFC 2.2 M 600.0MW 5%	01121	A-B TYPE EB OR EQUIV.
R 148	12124800A	RFF 68.1 K 500 MW F+1%	16299	CGW NA 60
R 149	12123400A	RFF 2.61K 500 MW F+1%	16299	CGW NA 60
R 150	12122000A	RFF 100.0 500 MW F+1%	16299	CGW NA 60
R 151	12129080A	RFF 1.21K 500 MW F+1%	16299	CGW NA 60
R 152	12127640A	RFF 56.2 K 1.0MW 1%	16299	CORNING NA 65
R 153	12124400A	RFF 26.1 K 500 MW F+1%	16299	CGW NA 60
R 154	12123560A	RFF 3.83K 500 MW F+1%	16299	CGW NA 60
R 155	12124240A	RFF 17.8 K 500 MW F+1%	16299	CGW NA 60
R 156	12122000A	RFF 100.0 500 MW F+1%	16299	CGW NA 60
R 157	12127640A	RFF 56.2 K 1.0MW 1%	16299	CORNING NA 65
R 158	12122400A	RFF 261.0 500 MW F+1%	16299	CGW NA 60
R 159	12123400A	RFF 2.61K 500 MW F+1%	16299	CGW NA 60
R 160	12127650A	RFF 10.0 K 4.0 W 5% METOX	16299	CORNING FP3 ADV.29481
R 161	12122000A	RFF 100.0 500 MW F+1%	16299	CGW NA 60
R 162	C510004CA	RVC 100. 0.5 WK +10%	73138	HEL TYP 72PM
R 163	12123280A	RFF 1.96K 500 MW F+1%	16299	CGW NA 60
R 164	12123240A	RFF 1.78K 500 MW F+1%	16299	CGW NA 60
R 165	12123160A	RFF 1.47K 500 MW F+1%	16299	CGW NA 60
R 166	12122000A	RFF 100.0 500 MW F+1%	16299	CGW NA 60
R 167	12127650A	RFF 10.0 K 4.0 W 5% METOX	16299	CORNING FP3 ADV.29481
R 168	C510000CA	RVC 1.0 K C.5 WK +10%	73138	HEL TYP 72PM
R 169	12123280A	RFF 1.96K 500 MW F+1%	16299	CGW NA 60
R 170	12127640A	RFF 56.2 K 1.0MW 1%	16299	CORNING NA 65
R 171	12123240A	RFF 1.78K 500 MW F+1%	16299	CGW NA 60
R 172	12122000A	RFF 100.0 500 MW F+1%	16299	CGW NA 60
R 173	12123240A	RFF 1.78K 500 MW F+1%	16299	CGW NA 60
R 174	12123240A	RFF 1.78K 500 MW F+1%	16299	CGW NA 60
R 175	12121000A	RFF 10.0 500 MW F+1%	16299	CGW NA 60
R 176	12124000A	RFF 10.0 K 500 MW F+1%	16299	CGW NA 60
R 177	12121400A	RFF 26.1 500 MW F+1%	16299	CGW NA 60
R 178	12125400A	RFF 261.0 K 500 MW F+1%	16299	CGW NA 60
TR 101	1C100010A	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 102	1C100010A	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 103	1C100010A	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 104	1C100010A	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 105	1C094730A	TRQ 2N3906	04713	MOTOROLA
TR 106	1C100020A	TRQ TRANSISTOR TYPE 2N930	04713	MOTOROLA
TR 107	1C100020A	TRQ TRANSISTOR TYPE 2N930	04713	MOTOROLA
TR 108	1C100010A	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 109	1C100010A	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 110	1C100010A	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 111	10094730A	TRQ 2N3906	04713	MOTOROLA
TR 112	10094730A	TRQ 2N3906	04713	MOTOROLA
TR 113	1C100020A	TRQ TRANSISTOR TYPE 2N930	04713	MOTOROLA
TR 114	10094730A	TRQ 2N3906	04713	MOTOROLA
TR 115	1C100160A	TRQ TRANSISTOR TYPE 2N5058	07263	FAIRCHILD
TR 116	1C100160A	TRQ TRANSISTOR TYPE 2N5058	07263	FAIRCHILD
TR 117	10094730A	TRQ 2N3906	04713	MOTOROLA

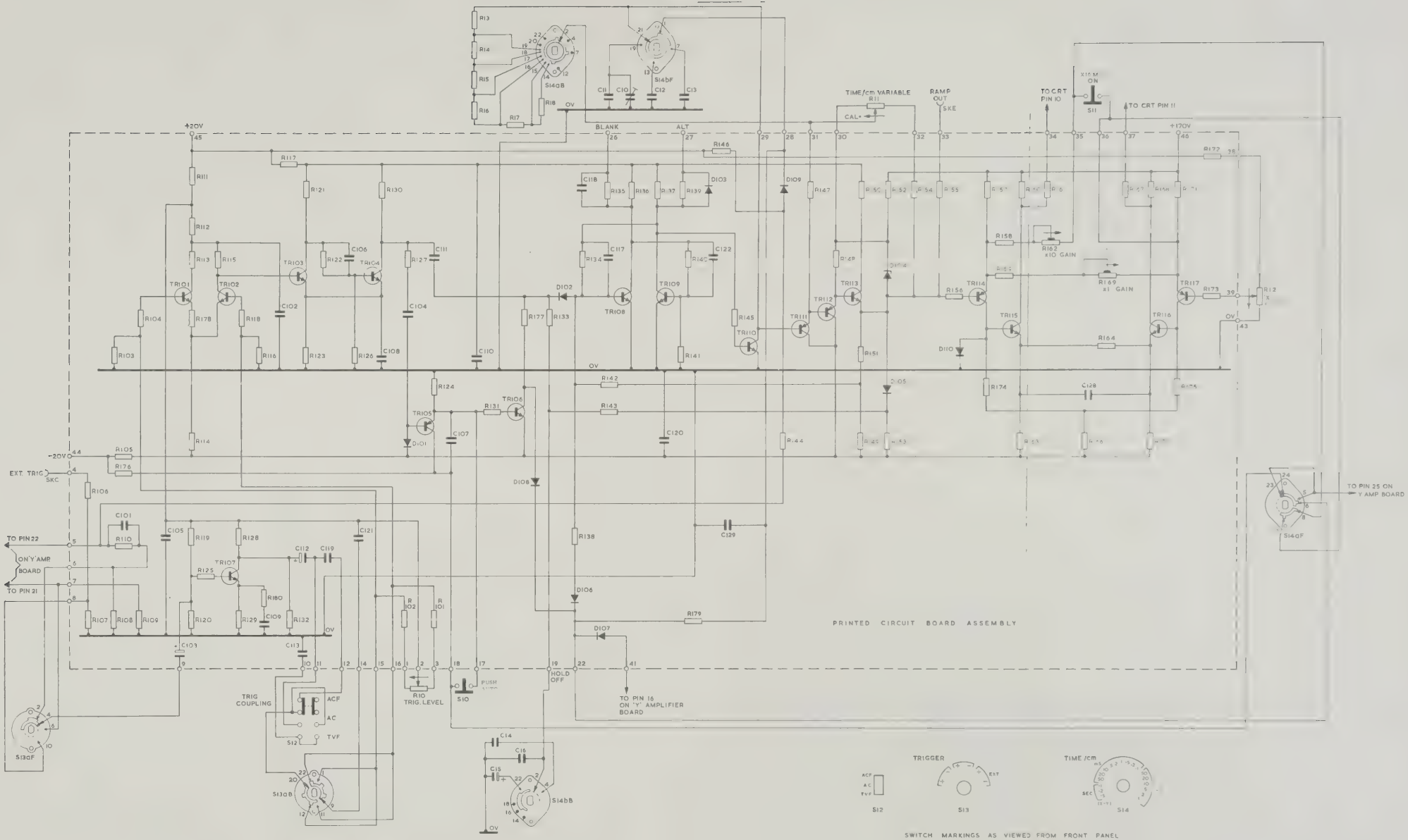


FIGURE 6-3. TIMEBASE & 'X' AMPLIFIER

POWER SUPPLY

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 301	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 302	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 303	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 304	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 305	07200120A	CCD 0.01UF 1.5KVK GMK	71590	CTL DD16-103
C 306	07200110A	CCD4700.0PF 4.0KVK+-10%	91418	HI-KHI-V DISCAP GMV
C 307	07200110A	CCD4700.0PF 4.0KVK+-10%	91418	HI-KHI-V DISCAP GMV
C 308	07200110A	CCD4700.0PF 4.0KVK+-10%	91418	HI-KHI-V DISCAP GMV
C 309	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 310	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 311	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 312	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 313	07101560A	CCD 2.2NF 2.K V Z5U GMV	72982	ERIE 3888 Z5U 2.2NF GMV2
C 314	07200120A	CCD 0.01UF 1.5KVK GMK	71590	CTL DD16-103
C 315	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 316	07100590A	CYF 4.7UF 100.0V M	34553	AMPEREX C280MAH/ANM7
C 317	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 318	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 319	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
D 301	05100460A	DRS 4. KV 0.25 AMP MR995A	04713	MOTOROLA
D 302	05100460A	DRS 4. KV 0.25 AMP MR995A	04713	MOTOROLA
D 303	05100460A	DRS 4. KV 0.25 AMP MR995A	04713	MOTOROLA
D 304	05100110A	DGP 1N4007	12954	DICKSON ELECTRONICS
D 305	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 306	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 307	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 308	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 309	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 310	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 311	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 312	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 313	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 314	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 315	05079100A	DZP 6.8V +-5% 1N957B	27832	HUGHES
D 316	05079100A	DZP 6.8V +-5% 1N957B	27832	HUGHES
D 317	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
MR 301	05100060A	DGP BRIDGE RECT. MDA920-6A	04713	MOTOROLA
R 301	12123720A	RFF 5.62K 500 MW F+-1%	16299	CGW NA 60
R 302	12123000A	RFF 1.0 K 500 MW F+-1%	16299	CGW NA 60
R 303	12123880A	RFF 8.25K 500 MW F+-1%	16299	CGW NA 60
R 304	09100080A	RVC 10.0 K 0.5 WK +-10%	73138	HEL TYP 72PM
R 305	12125000A	RFF 100.0 K 500 MW F+-1%	16299	CGW NA 60
R 306	12124640A	RFF 46.4 K 500 MW F+-1%	16299	CGW NA 60

POWER SUP

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION
R 307	1212188CA	RFF 82.5 500
R 308	1212300CA	RFF 1.0 K 500
R 309	12011090A	RFC 5.6 500 M
R 310	12123320A	RFF 2.15K 500
F 311	12123120A	RFF 1.33K 500
R 312	12124160A	RFF 14.7 K 500
R 314	12011090A	RFC 5.6 500 M
F 315	12121880A	RFF 82.5 500
R 316	12123320A	RFF 2.15K 500
F 317	12123120A	RFF 1.33K 500
F 318	12124640A	RFF 46.4 K 500
F 319	12124600A	RFF 42.2 K 500
F 320	09100080A	RVC 10.0 K 0.5
R 321	12126160A	RFF 1.47M 500
R 322	12200000A	RFF 3.3 M 2.0
R 323	12127630A	RFC 2.2 M 600.0
R 324	12124640A	RFF 46.4 K 500
F 326	12125000A	RFF 100.0 K 500
R 327	12124640A	RFF 46.4 K 500
F 328	12010800A	RFC 4.7M 500 M
F 329	12125400A	RFF 261.0 K 500
R 331	12126160A	RFF 1.47M 500
F 332	09100090A	RVC 250.0 K 0.5
R 333	09100080A	RVC 500.0 K 0.5W
R 334	12124640A	RFF 46.4 K 500
F 335	12127660A	RFF 27.0 K 2.0
R 336	12124170A	RFF 15.0 K 500
F 337	12124330A	RFF 22.1 K 500
F 338	12123640A	RFF 4.64K 500
F 339	12127630A	RFC 2.2 M 600.0
F 341	12127630A	RFC 2.2 M 600.0
R 342	12127630A	RFC 2.2 M 600.0
TR 301	10100120A	TRQ TRANSISTOR TY
TR 302	10100020A	TRQ TRANSISTOR TY
TR 303	10100020A	TRQ TRANSISTOR TY
TR 304	10094730A	TRQ 2N3506
TR 305	10094730A	TRQ 2N3506
TR 306	10100020A	TRQ TRANSISTOR TY
TR 307	10100010A	TRQ TRANSISTOR TY
TR 308	10100110A	TRQ TRANSISTOR TY
	33100000A	Power Cord, 6 foot

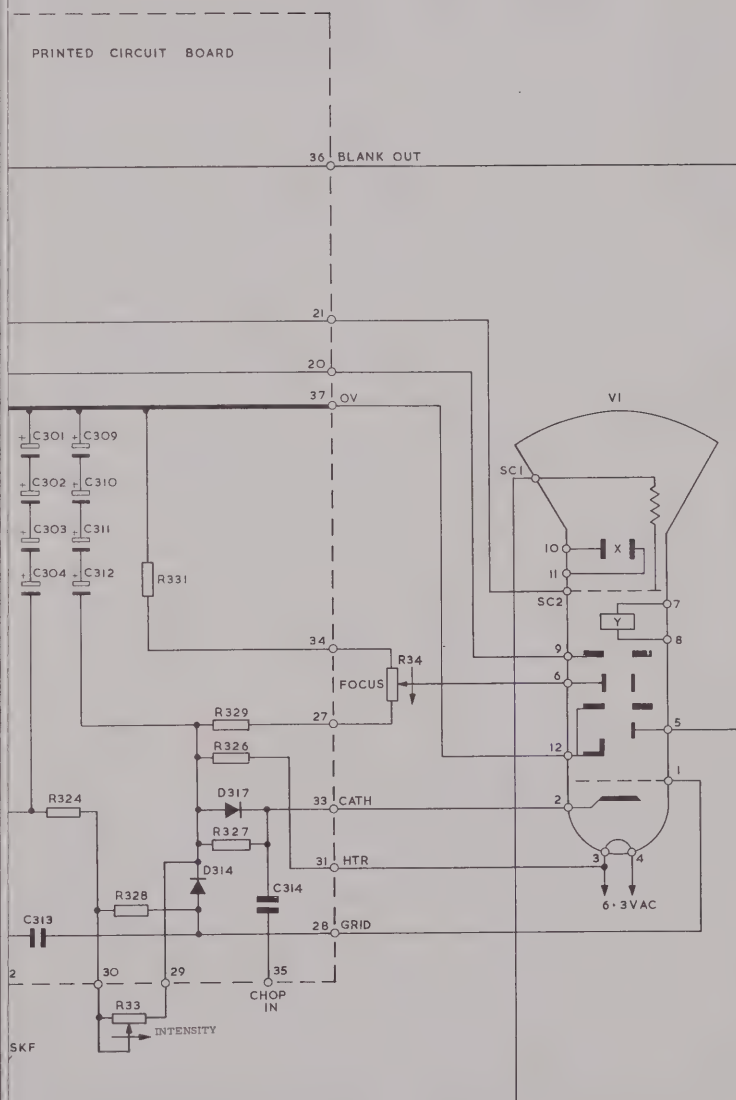


FIGURE 6-4. POWER SUPPLY

POWER SUPPLY

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 301	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 302	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 303	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 304	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 305	07200120A	CCD 0.01UF 1.5KVK GMK	71590	CTL DD16-103
C 306	07200110A	CCD4700.0PF 4.0KVK+-10%	91418	HI-KHI-V DISCAP GMV
C 307	07200110A	CCD4700.0PF 4.0KVK+-10%	91418	HI-KHI-V DISCAP GMV
C 308	07200110A	CCD4700.0PF 4.0KVK+-10%	91418	HI-KHI-V DISCAP GMV
C 309	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 310	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 311	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 312	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 313	07101560A	CCD 2.2NF 2.5K V Z5U GMV	72982	ERIE 3888 Z5U 2.2NF GMV2
C 314	07200120A	CCD 0.01UF 1.5KVK GMK	71590	CTL DD16-103
C 315	07101480A	CEA 4.0UF 450.0 V	56289	500D405F450EH7
C 316	07100590A	CYF 4.7UF 100.0V M	34553	AMPEREX C280MAH/ANM7
C 317	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 318	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
C 319	07095760A	CCD 10 NF 150 V T 40%	71590	CTL TYP DD-103 CAP
D 301	05100460A	DRS 4. KV 0.25 AMP MR995A	04713	MOTOROLA
D 302	05100460A	DRS 4. KV 0.25 AMP MR995A	04713	MOTOROLA
D 303	05100460A	DRS 4. KV 0.25 AMP MR995A	04713	MOTOROLA
D 304	05100110A	DGP 1N4007	12954	DICKSON ELECTRONICS
D 305	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 306	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 307	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 308	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 309	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 310	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 311	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 312	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 313	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 314	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
D 315	05079100A	DZP 6.8V +-5% 1N957B	27832	HUGHES
D 316	05079100A	DZP 6.8V +-5% 1N957B	27832	HUGHES
D 317	05100020A	DGP 1N914	12954	DICKSON ELECTRONICS
MR 301	05100060A	DGP BRIDGE RECT. MDA920-6A	04713	MOTOROLA
R 301	12123720A	RFF 5.62K 500 MW F+-1%	16299	CGW NA 60
R 302	12123000A	RFF 1.0 K 500 MW F+-1%	16299	CGW NA 60
R 303	12123880A	RFF 8.25K 500 MW F+-1%	16299	CGW NA 60
R 304	09100080A	RVC 10.0 K 0.5 WK +-10%	73138	HEL TYP 72PM
R 305	12125000A	RFF 100.0 K 500 MW F+-1%	16299	CGW NA 60
R 306	12124640A	RFF 46.4 K 500 MW F+-1%	16299	CGW NA 60

POWER SUPPLY (Continued)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R 307	1212188CA	RFF 82.5 500 MW F+-12	16299	CGW NA 60
R 308	1212300CA	RFF 1.0 K 500 MW F+-12	16299	CGW NA 60
R 309	12C11C50A	RFC 5.6 500 MW J+- 52	01121	A-B TYP EB
R 310	1212332CA	RFF 2.15K 500 MW F+-12	16299	CGW NA 60
F 311	1212312CA	RFF 1.33K 500 MW F+-12	16299	CGW NA 60
F 312	1212416CA	RFF 14.7 K 500 MW F+-12	16299	CGW NA 60
R 314	12C11C90A	RFC 5.6 500 MW J+- 52	01121	A-B TYP EB
F 315	1212188CA	RFF 82.5 500 MW F+-12	16299	CGW NA 60
F 316	1212332CA	RFF 2.15K 500 MW F+-12	16299	CGW NA 60
F 317	1212312CA	RFF 1.33K 500 MW F+-12	16299	CGW NA 60
F 318	1212464CA	RFF 46.4 K 500 MW F+-12	16299	CGW NA 60
F 319	1212460CA	RFF 42.2 K 500 MW F+-12	16299	CGW NA 60
F 320	C9100C80A	RVC 10.0 K 0.5 WK +-102	73138	HEL TYP 72PM
F 321	1212616CA	RFF 1.47M 500 MW F+-12	16299	CGW TYP NA 65
F 322	12200C00A	RFF 3.3 M 2.0 W 52HISTB	00327	WELWYN TYPE C25
F 323	1212763CA	RFC 2.2 M 600.0MW 52	01121	A-B TYPE EB OR EQUIV.
R 324	1212464CA	RFF 46.4 K 500 MW F+-12	16299	CGW NA 60
R 326	1212500CA	RFF 100.0 K 500 MW F+-12	16299	CGW NA 60
R 327	1212464CA	RFF 46.4 K 500 MW F+-12	16299	CGW NA 60
F 328	12C10C0CA	RFC 4.7M 500 MW K+-102	01121	A-B TYP EB
F 329	1212540CA	RFF 261.0 K 500 MW F+-12	16299	CGW NA 60
F 331	1212616CA	RFF 1.47M 500 MW F+-12	16299	CGW TYP NA 65
F 332	C9100C50A	RVC 250.0 K 0.5 WK +-102	73138	HEL TYP 72PM
F 333	C9100C80A	RVC 500.0 K 0.5WK 3C2 CERMET	73138	HELIPCT 72P TRIMPOT MINI
R 334	1212464CA	RFF 46.4 K 500 MW F+-12	16299	CGW NA 60
R 335	1212766CA	RFF 27.0 K 2.0 W 52	16299	CORNING TYPE C425
F 336	1212417CA	RFF 15.0 K 500 MW F+-12	16299	CGW NA 60
F 337	1212432CA	RFF 22.1 K 500 MW F+-12	16299	CGW NA 60
F 338	1212364CA	RFF 4.64K 500 MW F+-12	16299	CGW NA 60
F 339	1212763CA	RFC 2.2 M 600.0MW 52	01121	A-B TYPE EB OR EQUIV.
F 341	1212763CA	RFC 2.2 M 600.0MW 52	01121	A-B TYPE EB OR EQUIV.
R 342	1212763CA	RFC 2.2 M 600.0MW 52	01121	A-B TYPE EB OR EQUIV.
TR 301	1C1C012CA	TRQ TRANSISTOR TYPE MJE3439	04713	MOTOROLA
TR 302	1C1C002CA	TRQ TRANSISTOR TYPE 2N930	04713	MOTOROLA
TR 303	1C1C002CA	TRQ TRANSISTOR TYPE 2N930	04713	MOTOROLA
TR 304	1C09473CA	TRQ 2N2506	04713	MOTOROLA
TR 305	1C09473CA	TRQ 2N2506	04713	MOTOROLA
TR 306	1C1C002CA	TRQ TRANSISTOR TYPE 2N930	04713	MOTOROLA
TR 307	1C1C0010A	TRQ TRANSISTOR TYPE 2N2369	04713	MOTOROLA
TR 308	1C1C011CA	TRQ TRANSISTOR TYPE 2N5831	07263	FAIRCHILD
	3310000A	Power Cord, 6 foot	50423	

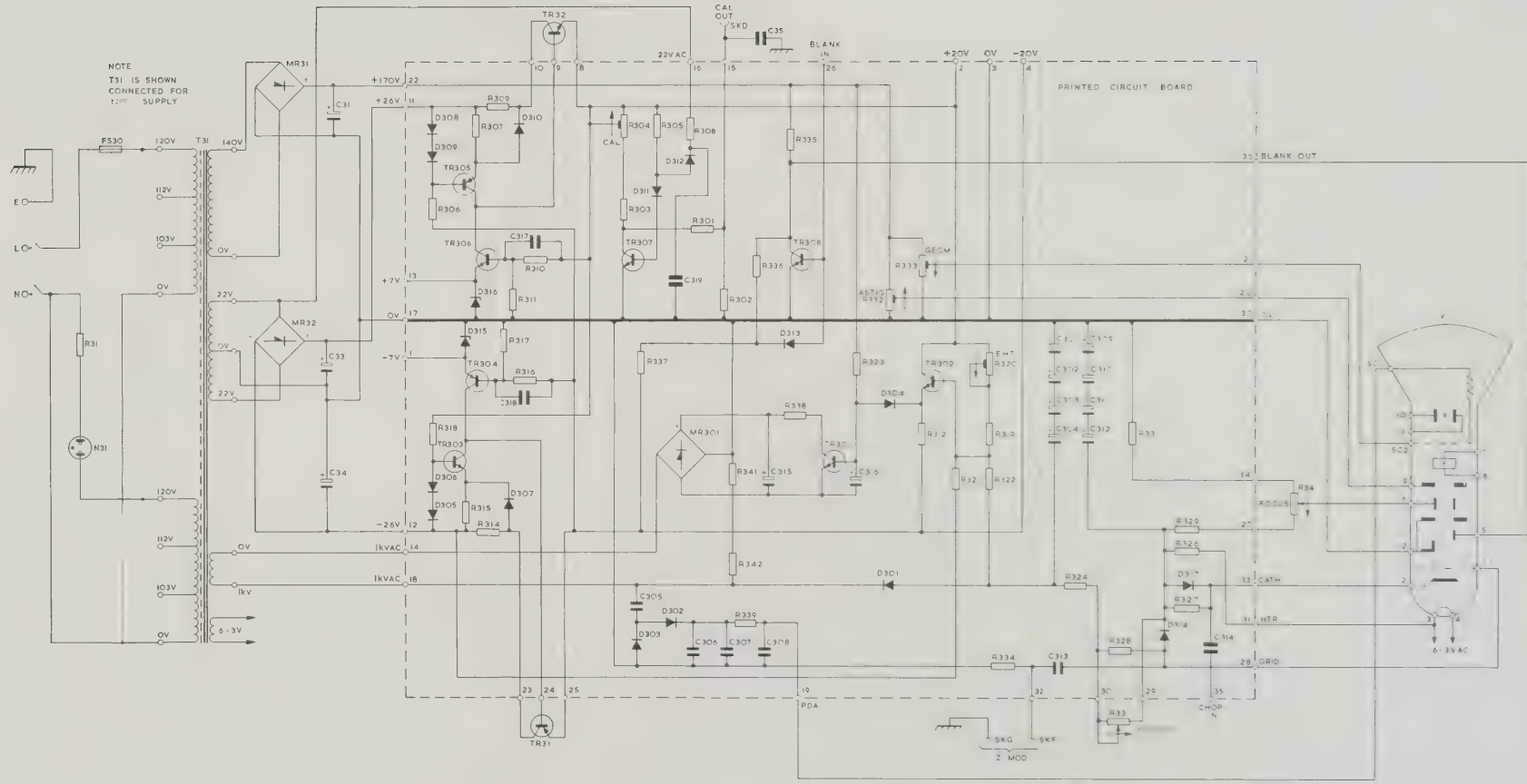


FIGURE 6-4. POWER SUPPLY

Notes

[illegible]This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

GIBBS MANUFACTURING AND RESEARCH CORPORATION
Calibration Data
Electronic Test Equipment

1. Test Inst. <u>"O" SCOPE</u> (Name of item calibrated) _____ 2. Manufacturer <u>BALLANTINE</u> 3. Model No. <u>1010</u> 4. Serial No. <u>031-0419</u> <u>New</u>	5. Reason for Submission Certification/Calib. ☒ <u>1</u> Crosscheck <u>2</u> Damaged or Abused <u>3</u> Operational <u>4</u> Failure _____ 6. Date of Last Servicing <u>New</u> 7. Servicing cycle (months) Certification/Calib. _____ Crosscheck <u>3 MO</u> 8. Calibration Procedure <u>Mfr</u>
---	---

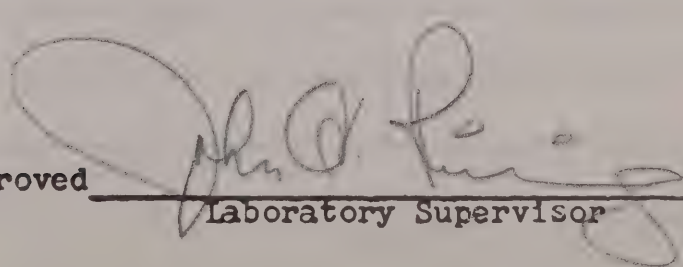
1. Calibration Tech. <u>JR2</u> 2. Test Date <u>23 MAR 74</u> 3. Certificated or Reported Value, if Fixed Standard _____ 4. Man-Hrs. to Calibrate <u>4.0</u> 5. Man-hrs. to Repair <u>1.5</u> (list in remarks) _____	6. Servicing Label Affixed Certification/Calib. ☒ <u>1</u> Crosscheck <u>2</u> Limited Use (Explain in remarks) _____ Reject <u>4</u> 7. Next Servicing Date <u>22 JUN 74</u> Certification/Calib. _____ Crosscheck _____
--	--

REMARKS

Power supply +20V ± 1V Read 21.190 V
Ch 1 input BNC LOOSE

Sheet _____ of _____

Approved _____


Laboratory Supervisor

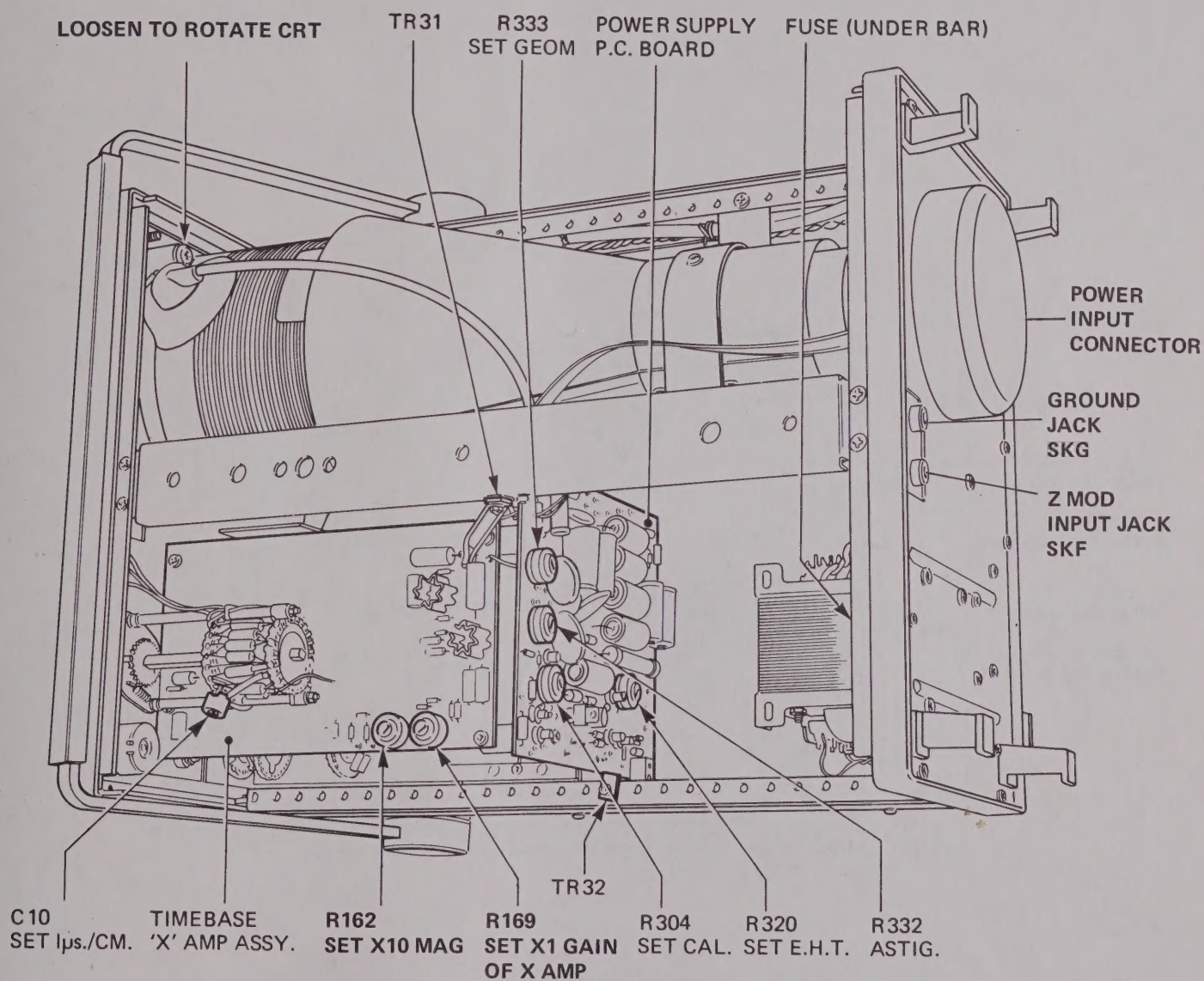


FIGURE 6-5. 1010A TOP VIEW

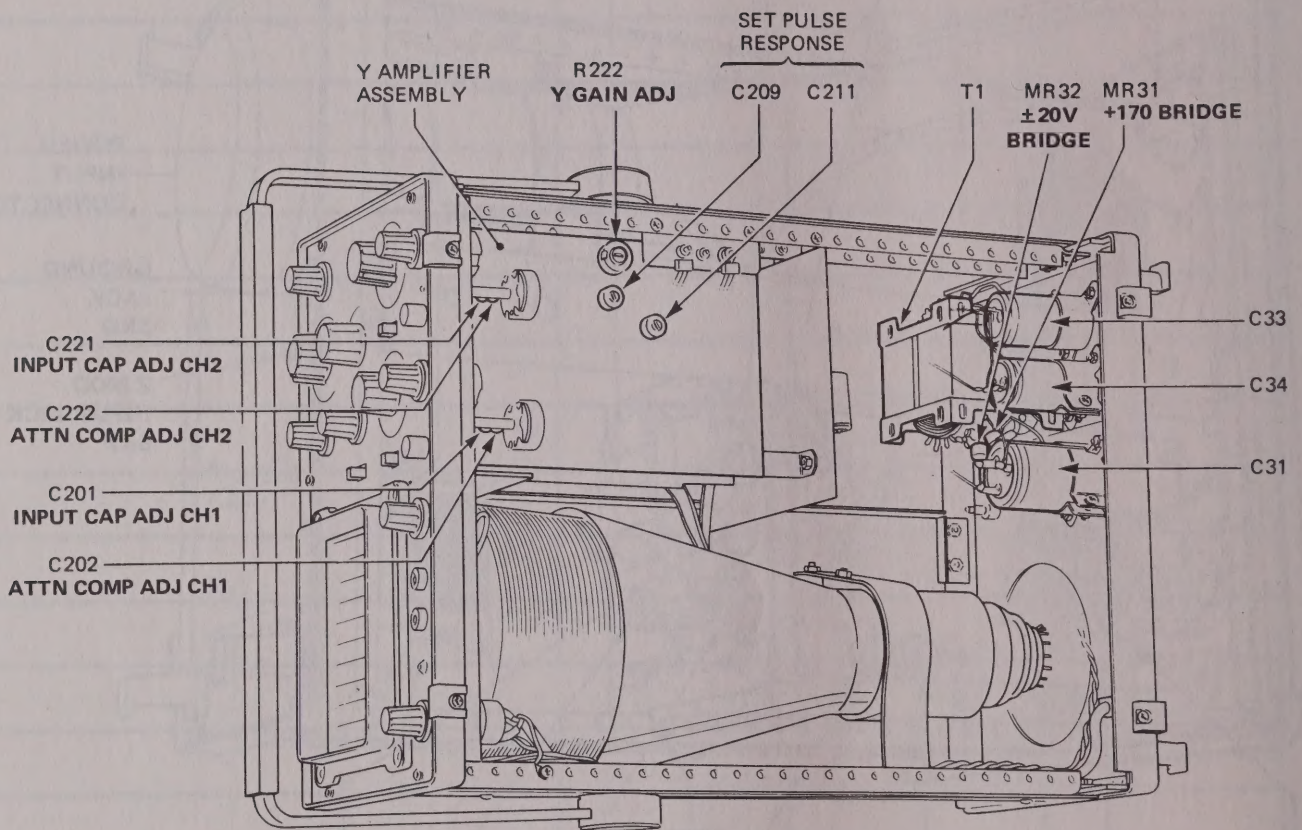


FIGURE 6-6. 1010A BOTTOM VIEW

